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Railway earnings in the United States for the six months ending June 30, 1893, show increases in both gross and net, according to statistics covering 121,173 miles, or 69.2% of the total mileage of the country, collected by the "Financial Chronicle." The results of operations for the six months is given as follows:

	1893.	1892.	Inc. P. c.
Gross earnings.....	$438,662,810	$423,542,661	3.53
Operating expenses.	311,841,013	297,978,698	4.60
Net earnings......	$126,821,797	$125,563,963	1.00

The comparison is better than would have been thought likely, considering the general depression in business. Classifying the roads by groups it is found that four, the New England, Trunk lines, Northwestern and the Pacific, exhibit decreases in net earnings varying from 5.37% to 1.28%, all others showing increases over the corresponding period of 1892. The largest increase in net is shown by the Middle Western group, 14.49%. It is to be remembered in considering these figures that the present business prostration did not begin until after July 1, so that its effects are not felt to any great extent in railway earnings of the first half of the year. At present earnings are showing large decreases.

A memorial gate is to be erected at Detroit in honor of Chauncey Hurlbut, a former member of the Board of Water Commissioners of that city, who in his will bequeathed a large fortune to the city for the maintenance of the grounds about the pumping works and reservoirs as a public park. The memorial gate will be erected at the entrance to this park.

The Midwinter International Exposition, to be held at San Francisco this winter, promises to be a copy on a very diminutive scale of the Columbian Exposition; the buildings proposed in the prospectus have the same names as those at Jackson Park, and are to be ornamented with the staff decoration that has proved such a success there. The list of buildings at present announced includes a Manufactures and Liberal Arts building, 450 × 200 ft.; a Fine Arts building, 120 × 60 ft.; an Agricultural and Horticultural building, 300 × 125 ft.; a Mechanical Arts building, 275 × 175 ft., etc. The transcontinental railways have announced that exhibits shipped to San Francisco will be returned free, or, in the case of perishable goods or articles which it is not desired to return, special reduced rates will be given. The promoters of the Exhibition doubtless hope that a goodly number of the exhibitors at Chicago will be glad of the opportunity to take their goods to another point where the public can be attracted after the Columbian Exposition closes.

Chicago's unemployed are to be given work on the Chicago drainage canal so far as possible. The contractors who are behind in their work, are to have pressure brought to bear to induce them to increase their force. On the section between Summit and Chicago, 7 miles, work is to be undertaken at once by the Drainage Board without the letting of contracts. The resumption of work on the McArthur Bros. section when that contract is relet will also give employment to additional hands.

Air brakes are being applied to the electric cars on the Atlantic Ave. line in Brooklyn.

Three officers of the Old Colony R. R. have been sentenced to one month's imprisonment in the House of Correction for rioting in resisting the attempt of an electric railway company to lay a grade crossing over the Old Colony tracks at Abingdon on Aug. 16. The officials who are in this predicament are: Supt. John C. Sanborn, Detective Bailey and Roadmaster Bryant.

A new form of electric arc lamp, invented by Mr. Louis E. Howard, of New York city, was described by Prof. W. D. Marks in a paper before the recent Electrical Congress at Chicago. The carbons are inclosed in a tight glass globe of small size, closely fitted to the lower carbon, and fitted to the upper carbon as tightly as is possible without interfering with its motion. When current is first turned on, the oxygen contained in the air in the interior of the globe at once combines with the carbon to form carbonic dioxide, so that the globe is soon filled with a mixture of inert gases which cannot support combustion. The carbon vapor from the glowing arc is deposited on the interior of the glass and so confines the radiant energy from the arc that the whole globe and the gases within it become heated to a high temperature and glow like the carbon in an incandescent lamp. The arc itself can hardly be distinguished, the light appearing to proceed from the whole mass of the globe. Of course the glass globe must be of highly refractory material, and the smaller its size the higher the efficiency. By way of comparison it may be said that ordinary incandescent lamps give from 150 to 200 c. p. per electrical HP. of energy consumed; the arc lamp, from 500 to 1,000 c. p. The new lamp above described is said to have showed an efficiency of 888 c. p. per E. HP. in tests recently made at Cornell. The advantages of the new lamp are its greater steadiness, pleasanter light (the intense glare of the ordinary arc lamp being done away with), and saving of carbons, the consumption of the positive carbon being only 1% to 5% of the consumption in an ordinary arc lamp.

The most serious railway accident of the week, and of many weeks, was a rear collision, which occurred at 11:45 p. m. Aug. 26 on the Long Island R. R. in the outskirts of Long Island City, and which caused the death of 16 persons and the injury of 30. The train run into was a heavily crowded extra from Manhattan Beach made up of an engine and five day coaches. From some cause still in dispute this train was stopped in the block between the Berlin and Bushwick towers. The tower man in charge of the signals in the rear of the train claims that they were properly set at danger. A train from Rockaway Beach which was running close behind ran past the block signal, which the engineer claims was set at safety, and crashed into the rear of the Manhattan Beach train just as it was getting under way.

Whether the tower man or the engineer was at fault will require the official investigation to determine, as each lays the blame on the other; but such corroborative evidence as is at hand tends to fix the blame upon the engineer. An investigation of the circumstances of the accident is to be made by the coroner's jury and by the State Railroad Commission.

Another serious collision occurred in the vicinity of New York city only a few hours earlier than the one noted above. Two passenger trains on the Harlem R. R. met head on while passing around a curve in a cutting near Dykeman's. One passenger and the engineers and firemen on both trains were killed and six others were injured. The collision was due to a mistake in the meeting orders, the responsibility for which lies between the train dispatcher and a telegraph operator, who received the order. According to one statement the operator, under close questioning, has confessed that he anticipated the dispatch, or wrote out the part fixing the meeting place before he received it over the wire.

The severest wind storm that has been experienced for a long time swept the Atlantic coast from Florida to New England on Aug. 28, causing great damage to property and the loss of many lives. The storm extended as far westward as Chicago, but the greatest damage was done in the South, in cities along the coast.

The wire cables attached to an elevator car in the Woman's Building at the Columbian Exposition parted on Aug. 23, and the car fell about 6 ins. before it was stopped by the safety catches. No one was injured but the accident came near causing a panic, and deserves an investigation. A passenger elevator should be suspended by cables with a sufficient factor of safety to make breakage impossible.

A bridge accident on the Beech Creek R. R., near Eddie Lick, Pa., Aug. 26, is reported as follows by a correspondent:

> The accident was caused by a train parting. The drawhead pulled out and dropped on the rail when the train was half way over the bridge. The cars left the track and knocked the bridge down, completely wrecking it. The bridge was a 132-ft. pin-connected through Pratt truss, built by the Keystone Bridge Co. in 1884.

The foundations of the new Stock Exchange building in Chicago consist of piles and wells filled with concrete, the latter being used where pile-driving would be dangerous to adjacent buildings. Below the top stratum of mud in this locality is a stratum of clay about 55 ft. deep containing about 17 lbs. of water per cubic foot of material. This water squeezes out gradually under a sufficient load as long as there is an outlet, and though this clay will support from 1½ to 2 tons per square foot for several days, the load then gradually commences to settle at the average rate of about 1-16 in. per month and may continue to settle thus for years. Gen. Wm. Sooy Smith, the consulting engineer, determined to found the building upon the hard clay stratum below this water permeated stratum, and used piles mainly for this purpose. The wells employed near other buildings were 5 ft. in diameter and about 55 ft deep. They were made of oak poling boards about 3 ft. long supported inside with steel hoops. When the hard bottom was reached the column was widened out in a cone with a 7½ ft. base, and the whole filled with concrete forming a solid base for the heavy building to be placed upon.

The "Souvenir Bulletin" issued in Machinery Hall Day, Aug. 26, at the World's Fair, is a striking example of rapid newspaper and mechanical work. It is only 4 pages, octavo in size, but the paper mill was started at 10 a. m. to make the stock for this issue of the "Bulletin," and in 63 minutes thereafter the paper was printed ready for issue. To accomplish this result the resources of electricity, paper-making, type-casting, type-setting and printing were harnessed together. The Western Union Telegraph Company made direct connection between Buzzard's Bay, Washington, D. C., and the Mergenthaler exhibit of linotype machines. The keyboard of one of these machines was operated by a man capable of reading the messages from the wire and manipulating the keys at the same time. This machine set and cast the type ready for the press. Meanwhile the paper was being made, finished and cut, commencing with the paper pulp, by the machines of the American Paper Makers' Exposition Company, and the printing was done on the "new movement" Campbell pony press at the rate of 3,000 copies per hour.

The sewage polluted water surrounding the pier of the Albany Day Boat line at the foot of Canal St., at the North River, is being treated by a plant erected by the Woolf Electric Disinfecting Co., of New York. The process was described in our issue of July 13, 1893. The Canal St. plant discharges 1,000 or more gallons per hour of the electrozone into the water of two slips through jets and atomizers some 6 to 10 ft. apart, connected with a 1½-in. wrought iron pipe. The pipe is only a foot or two below the floor line of the pier, and the spray of electrozone is thrown outward into the air instead of discharged under water, as might be expected. It is claimed for the plant that it will deodorize and disinfect the water in the slip and render harmless any gases arising from it. The cost of the plant is said to be $4,000.

The application of an electric feeder to the Gatling gun has, according to a Hartford news item, almost doubled its capacity. By applying a small electric motor to the breech of the gun Dr. Gatling has succeeded in increasing the rapidity of fire from 3,120 times a minute to about 5,000 times per minute.

THE HISTORY OF THE HAVERHILL AQUEDUCT CO., 1801-1892.

Within the past few years several cities of size and many small cities and towns have bought the works of the companies furnishing their water supplies. It seldom occurs that a price can be agreed upon without arbitration, and in the course of such proceedings engineers are often called upon for testimony of a more or less technical nature. Aside from mere questions of construction and its expense, there are others of great importance relating to the rights and franchises of companies which have some interest, at least, to engineers, and great interest to the officials of water companies and holders of this form of securities.

One of the most interesting recent changes from private to public ownership occurred at Haverhill, Mass., in 1891-2, where the Haverhill Aqueduct Co. took steps to supply water as early as 1801 and did actually supply it from 1803 until it surrendered its works to the city in 1891.

Under statutes which will be referred to further on, but which are common, with possible variations, to most other Massachusetts cities or towns where water supplies are furnished by private companies, on July 6, 1891, the city of Haverhill "took" the works of the Haverhill Aqueduct Co. and soon after the Supreme Judicial Court appointed as commissioners to fix the price to be paid for the works Messrs. Geo. O. Shattuck, John E. Sanford and Weston Lewis.

An attempt made in 1798 to secure the incorporation of a company to supply Haverhill with water failed through opposition of the people of the town.

In 1801 Benj. Willis, Jr., one of the first directors of the Haverhill Aqueduct Co., and others, applied to the town for permission to conduct the water of Round Pond into any part of the town. The report of the town meeting of May 14, 1802, shows the manner in which an application for a waterworks franchise was treated 92 years ago in a Massachusetts town, when only five towns in the state and 17 in the United States had public water supplies. Preserving the orthography and punctuation the report, so far as it relates to the petition, is as follows:

The Report of the Committee on the Pitition of Benjamin Willis, Jun., and others was read and accepted.

Voted that the Report be left in the Care of the Selectmen for their Regulation.

The Committee on the petition of Benjamin Willis, Junr., and others report that in their Opinion the bringing of the water in pipes from the round pond for the supply of the Inhabitants in the Center of Town would be of public Service and if there has been no previous Grant of right of the water for the use of mills (which your Committee have not had time to examine into) they recommend to the Town to give leave to the petitioners and others to form a company for that purpose under such regulations as will Intitle any Individual in the Town to a right in Said Company provided he becomes a subscriber for which purposes the present petitioner shall have a Subscription paper in Sum public place and give notice in the Haverhill paper of the sam and no person Shall be all allowed to Subscribe for more than one Share untill the Same has been So offered for ninety days at the expiration of which time the Subscribers may take all Shares not before Subscribed making in the whole not less than an Hundred and Call a meeting of the Subscribers to form rules and regulations to be offered to the Town for their further approbation.

The action of the selectmen on this report is not stated in the information at hand, but in 1802 the Haverhill Aqueduct Co. was organized with 100 shares of stock, the number named in the report, and in 1803 it began to supply water from Round Pond.

The company organized under an act of the Massachusetts Legislature dated Feb. 21, 1799, entitled, "An Act Enabling Proprietors of Aqueducts to Manage the Same." Under this act provisions were made for the organization and general conduct of aqueduct companies. Authority was given such companies to hold real estate to the value of not over $30,000, but the right of eminent domain was not granted and no provision was made for the acquirement of a water supply. Power was given to dig up streets and lay pipe in the same, but only upon written permission of a majority of the selectmen of the town. The important provision was inserted that any town, in which an aqueduct had been placed under the provisions of this act might draw water from the same for fire protection without paying the company for the water, the town to provide the necessary facilities. Under the last-named provision the town and afterward the city established fire hydrants, free of rental.

In 1867 the legislature authorized the company "to take and use the waters of Round Pond and Plug Pond, so called (now Lake Saltonstall), and Kenoza Lake, in the town of Haverhill, to supply the inhabitants of said town with water." The use of water to drive machinery, otherwise than by steam, was prohibited, as was raising the high or lowering the low water mark in the ponds.

It will be noticed that the company was given authority to "take and use" the water of Round Pond, which it had been using since 1803, this being the first legislative permission obtained by the company to draw water from this or any other source. The act also gave the company the right of eminent domain, for the first time, and authorized it to hold real and personal estate to the amount of $100,000.

The act also contained the important provision that the town might at any time thereafter purchase the company's works at a price to be agreed upon, or in case of non-agreement, at a price to be fixed by three commissioners appointed by the Supreme Judicial Court.

Under this act the company began to supply water from Lake Saltonstall, and in 1871 began to pump water from Kenoza Lake to Round Pond, to supplement the gravity supply. In 1879 a 2,000,000-gallon Worthington pump was erected at Kenoza Lake and a 200,000-gallon stand-pipe was built and put in use for high service. In 1880 or 1881 a second 2,000,000-gallon Worthington pump was added at this station.

Yearly Stock Assessments and Dividends and Totals to the End of Each Year from 1802 to 1891, inclusive.

	Assessments. For year.	Assessments. To end of year.	Dividends. For year.	Dividends. To end of year.		Assessments. For year.	Assessments. To end of year.	Dividends. For year.	Dividends. To end of year.		Assessments. For year.	Assessments. To end of year.	Dividends. For year.	Dividends. To end of year.
1802	$12½	$12½	.....	.....	1832	....	$3,937½	.....	$1,550	1862	....	$19,137½	$3,000	$28,050
1803	1,500	1,512½	.....	.....	1833	....	3,937½	.....	1,550	1863	....	19,137½	3,000	31,050
1804	300	1,812½	$75	$75	1834	....	3,937½	.....	1,550	1864	....	19,137½	3,000	34,050
1805	....	1,812½	150	225	1835	....	3,937½	.....	1,550	1865	....	19,137½	3,000	37,050
1806	....	1,812½	125	350	1836	....	3,937½	.....	1,550	1866	....	19,137½	3,000	40,050
1807	....	1,812½	100	450	1837	....	3,937½	.....	1,550	1867	....	19,137½	.....	40,050
1808	....	1,812½	100	550	1838	$1,000	4,937½	.....	1,550	1868	....	19,137½	3,000	43,050
1809	....	1,812½	150	700	1839	800	5,737½	.....	1,550	1869	....	19,137½	3,000	46,050
1810	....	1,812½	100	800	1840	....	5,737½	.....	1,550	1870	....	19,137½	3,000	49,050
1811	....	1,812½	100	900	1841	600	6,337½	.....	1,550	1871	....	19,137½	3,000	53,050
1812	....	1,812½	.....	900	1842	....	6,337½	.....	1,550	1872	....	19,137½	6,000	58,050
1813	....	1,812½	.....	900	1843	....	6,337½	.....	1,550	1873	....	19,137½	6,000	64,050
1814	....	1,812½	.....	900	1844	1,000	7,337½	.....	1,550	1874	....	19,137½	6,000	70,050
1815	525	2,337½	.....	900	1845	....	7,337½	.....	1,550	1875	....	19,137½	6,000	76,050
1816	....	2,337½	.....	900	1846	....	7,337½	.....	1,550	1876	....	19,137½	6,000	82,050
1817	....	2,337½	.....	900	1847	....	7,337½	.....	1,550	1877	....	19,137½	9,000	91,050
1818	....	2,337½	.....	900	1848	500	7,837½	.....	1,550	1878	....	19,137½	12,000	103,050
1819	....	2,337½	.....	900	1849	4,300	12,137½	.....	1,550	1879	....	19,137½	12,000	115,050
1820	....	2,337½	.....	900	1850	....	12,137½	$1,100	2,650	1880	....	19,137½	12,000	127,050
1821	500	2,837½	.....	900	1851	....	12,137½	800	3,450	1881	....	19,137½	12,000	139,050
1822	1,100	3,937½	.....	900	1852	....	12,137½	2,000	5,450	1882	....	19,137½	12,000	151,050
1823	....	3,937½	.....	900	1853	2,000	14,137½	800	6,250	1883	....	19,137½	12,000	163,050
1824	....	3,937½	200	1,100	1854	....	14,137½	1,000	7,250	1884	....	19,137½	15,000	178,050
1825	....	3,937½	250	1,350	1855	5,000	19,137½	2,800	10,050	1885	....	19,137½	18,000	196,050
1826	....	3,937½	.....	1,350	1856	....	19,137½	2,500	12,550	1886	....	19,137½	18,000	214,050
1827	....	3,937½	100	1,450	1857	....	19,137½	3,000	15,550	1887	....	19,137½	18,000	232,050
1828	....	3,937½	100	1,550	1858	....	19,137½	1,500	17,050	1888	....	19,137½	18,000	250,050
1829	....	3,937½	.....	1,550	1859	....	19,137½	3,000	20,050	1889	....	19,137½	18,000	268,050
1830	....	3,937½	.....	1,550	1860	....	19,137½	3,000	23,050	1890	....	19,137½	18,000	286,050
1831	....	3,937½	.....	1,550	1861	....	19,137½	3,000	26,050	1891	....	19,137½	18,000	304,050

In 1879 the company bought a small reservoir supplied by springs, used by the Silver Hill Aqueduct Co. to supply a few houses near the reservoir.

In 1882 the company acquired mill privileges on a stream flowing from Crystal Lake, in the western part of the city, and in 1884 it secured from the legislature authority "to take and hold the waters" of this lake for the purpose of increasing its water supply. The act granting this privilege was in intent much like the act of 1867, outlined above, containing the same privilege for purchase. The company laid a pipe line from Crystal Lake into the city and began to supply water from the lake in 1885.

In 1889 a 560,000-gallon stand-pipe or tank was erected by the company.

In 1891 the city of Haverhill petitioned the legislature for authority to use the water of the four lakes forming the source of supply of the Haverhill Aqueduct Co., subject to the rights of the company, for the purpose of supplying the city with water. The legislature granted the petition under condition that the city should buy the "franchises, rights and property" of the company, after which the city, by terms of the act, should "have the sole, exclusive and perpetual right to hold the waters of Round Pond, Plug Pond (Lake Saltonstall), Kenoza Lake and Crystal Lake, great ponds within said city of Haverhill, as a source of water supply." Full powers for the construction and operation of works were granted the city, but it was stipulated that the act should not "be construed to lessen, impair, enlarge or affect the franchises, rights and property heretofore lawfully granted to the or acquired by the Haverhill Aqueduct Co.," or in any manner affect the rights of the city to buy the company's works. The city "took" the works July 6, 1891, as has been stated, but the company remained in possession until Nov. 14, 1891, and collected all rates for water used to Dec. 31, 1891.

The total drainage area of the four ponds, as determined from the state topographical maps, was taken as about 3,200 acres, or some 2,700 acres excluding water areas. This was agreed to by both sides, subject to correction. Some of the testimony taken was to the effect that this area was too small, and some that it was too large.

The engineers' estimates of the average daily water supply that could be drawn from the supply ponds was made up on a somewhat different basis, as will be seen from the following: The average daily yield of the drainage area through a long period of years was estimated by Mr. Wm. Wheeler, of Boston, as 3,329,000 gallons. The average daily yield in the driest year was estimated by Mr. Nathaniel Crafts, of Boston, as 3,652,500 gallons. These estimates were based upon the use of the four ponds in their present condition, and were subject to increase by the possible increase of the storage capacity. Mr. Desmond FitzGerald, also of Boston, took a more conservative view and based his estimate on a change of location of one of the dams and the abandonment of Plug Pond, as being unsafe for future use, owing to population in its drainage area. His estimate of the safe yield of the three remaining ponds was 2,600,000 gallons per day. The capacity of the omitted pond was not claimed by any one to be more than 270,000 gallons per day. The population of the city in June, 1890, was 27,142. The extent and character of the whole pipe and conduit system of the water-works at the time of the taking, July 6, 1891, was as follows:

Size, in.	Wrought iron and cement.	Cast iron.	Lead and iron.	Wooden intake conduits.	Total.
20	.....	12	......	......	12
16	20,736	1,380	......	......	22,116
12	7,685	5,920	......	......	13,605
10	1,860	5,963	......	......	7,823
8	9,991	13,282	......	......	23,273
6	16,840	34,267	......	......	51,107
4	15,542*	50,201*	......	......	65,743*
3	......	2,537	......	......	2,537
2	......	21,034	......	......	21,034
1¼†	......	......	9,786	......	9,786
....	......	......	......	1,721	1,721
Total ft.	72,615	134,596	9,786	1,721	218,757*
" miles	13.7	25.5	1.8	0.3	41.4*

* A discrepancy of some 700 ft. appears in the report of the case, so that the total length of 4-in. pipe and the grand total above is about 700 ft. larger than in the report.

† 1½-in. and less.

The total number of gates on the system July 6, 1891, was 266, including 51 blow-offs. The number of service taps on the same date was about 3,300, nearly double the number about 10 years previous, April 30, 1881, which was 1,776.

The financial history of the company, considering the 90 years of its existence, is very complete and interesting.

The construction account from 1802 to July 6, 1891, was $490,040. This includes real estate, legal and traveling expenses and other items, some of which the city claimed should have been charged to the expense or operating account. The company claimed no present value for actual construction prior to May 1, 1866, although some of that construction is still in use. Including $14,035 paid for real estate prior to May 1, 1866, and deducting real estate sold, the company claimed that the cost of all their real estate and works proper, of value on July 6, 1891, was $344,592, of which $295,051 was the actual cost of construction of the present works, and $49,541 the cost of land, buildings and mill rights.

Of the $490,090 claimed to have been paid out for construction and real estate, all was derived from earnings except $19,137 assessed upon the shares prior to 1856.

The yearly dividends and assessments of the company from 1802 to 1891, inclusive, were presented at the hearing and are given in the accompanying table, the totals at the end of each year having been added as a matter of interest.

In 1882 the stock of the company was increased from 100 to 1,500 shares and its par value placed at $200 per share. The new stock was mostly held by two men, a resident of Philadelphia owning 720 and a resident of Haverhill 600 shares, in addition to which an out-of-town estate held 105 shares. Popular complaint arising against the company it was decided to try to quell or lessen it by distributing stock among some of the prominent citizens. The large local stockholder thought that the superintendent of the company, who had served it long and faithfully, should be given an interest. The Philadelphian was therefore requested to give the superintendent some stock, since as a non-resident he had not stood the brunt of building up the company and done a large amount of work without pay. Accordingly this non-resident holder donated to the superintendent 45 shares of stock, the same number to some one else, not named, and placed in the superintendent's hands 30 shares to be sold at $250 a share to such parties as three of the local stockholders, including the superintendent, should select. This was called a "strengthening process." The stock was sold to bank and city officials and others, prominent men, in lots of from 1 to 10 shares and only one person to whom it was offered refused it.

A comprehensive exhibit of the recent financial operations of the company is presented in the table below. This table gives the expense account, gross and net receipts, total dividends and the cost of construction for the years 1871 and 1876 and for the 11 years 1881 to 1891, reported by the company as follows:

	Expense account.	Gross receipts.	Net receipts.	Dividends.	Construction.
1871......	$4,188	$15,872	$11,684	$3,000	$14,454
1876......	9,058	23,022	13 964	6,000	4,585
1881......	14,193	38,803	24,610	12,000	14,451
1882......	14,371	39,449	25,077	12,000	11,682
1883......	18,062	45,962	27,900	12,000	16,063
1884......	17,017	4 ,910	29,893	15,000	6,680
1885......	16,092	50.568	34,476	18,000	7,749
1886......	15,650	57,551	41,901	18,000	56,792
1887......	17,189	61,313	44,124	18,000	8,680
1888......	19,204	65,940	46,736	18,000	10,699
1889......	18,473	72,253	53,780	18,000	27,454
1890......	20,359	78,479	58,120	18,000	10.909
1891......	22,456	85,265	62,809	18,000	21,890

Coming now to the price which the city ought to pay the company for its property, the engineer's estimates of the cost of replacing it may first be given. Mr. Desmond FitzGerald, M. Am. Soc. C. E., estimated the cost of replacing the present plant, excluding real estate, water rights and legal expenses, and including engineering and contingencies, at about $272,000. An estimate made by Mr. Freeman C. Coffin, independent of the above, placed the cost at $266,087. Mr. FitzGerald estimated that to put the present works in proper condition to meet the wants of the city $352,000 would be required, and Mr. Coffin placed the cost at $283,000 for the cheapest and $382,000 for the best plan.

In 1890 one of the directors sold 1-12 of the capital stock of the company, or 125 shares, to the superintendent at $250 per share, which would make the whole stock worth $375,000. This, the city urged, indicated the value of the property.

Both sides agreed, it appears, that the value of the constructed works and real estate was in the vicinity of $350,000, but the company claimed liberal compensation for the value of its franchise and prospective earnings at the time of the taking, and also for the rights to the water of the four great ponds. Considering only net earnings as a basis of present value the counsel for the company argued that the earnings 10 years hence should be taken. From the past increase in population, number of taps, operating expenses and revenue, the engineer for the company, Mr. William Wheeler, estimated the net receipts in 1901, 10 years after the taking, as $125,170, and from this a valuation of $3,000,000 or more was deduced. In answer Mr. Wm. H. Moody, one of counsel for the city, urged that while in operation the company was entitled to earn a fair dividend and money for the replacement of the plant and that the city was also entitled to purchase the property at such a price as would enable it to do the same. If the $60,000 of net earnings shown in 1891 by the company was more than a fair and reasonable return for the $358,000 which he claimed represented the company's investment, then the rates had been too high.

As to the company's rights in the four great ponds, the counsel for the city urged that the legislature merely granted it the right to use the water of these ponds until such a time as the city saw fit to buy the company's works. Kenoza Lake was used by the company from 1803 to 1867 without authority from the legislature, but the company claimed by this usage a prescriptive right. Then, why, the city asked, did the company obtain in 1867 legislative authority to use Kenoza Lake? These four ponds were great ponds, whose ownership was vested in the commonwealth. The acts quoted from above gave the company the right "to take and use" and "to take and hold" the water of the ponds, but to the city, in case it bought the property of the company, was granted the exclusive and perpetual right in the ponds.

After hearing all the evidence and arguments of both sides, the commissioners of appraisal on Oct. 17, 1892, reported the price which the city should pay for the property as $637,500, with interest from the date of the taking. The commissioners in such cases, it seems, fix their own fees, which in this instance amounted to $7,655, and was awarded to be paid by the city. The award amounted to nearly 10% upon the net earnings of the company in 1891, was a little over $400 per share, double their par value, was only about one-fifth of the amount claimed by the company and about 135% above the estimated cost of replacing the plant, as calculated by the engineers for the city.

We have been unable to learn the basis upon which the commissioners made their award. We are indebted to Mr. Wm. H. Moody, of Haverhill, and to Mr. Desmond FitzGerald, M. Am. Soc. C. E., Brookline, Mass., for courtesies extended in connection with the preparation of this article.

HARLEM RIVER DRAWBRIDGE; NEW YORK CENTRAL & HUDSON RIVER R. R.

(With inset.)

A very interesting and expensive part of the improvement which the New York Central & Hudson River R. R. is now making on its line entering New York city is the construction of a high level swing bridge across the Harlem River, some details of which we illustrate on our inset sheet this week. The general plan of the whole improvement contemplated by the company has already been given in considerable detail in our issues of April 13, May 25 and June 15, 1893, but may be summarized briefly as consisting of the construction of a four-track viaduct from 110th St. to the Harlem River, and a high level four-track swing span across the river with a short viaduct approach and an elevated embankment on the north. The swing span, while considerably shorter than several others built in recent years, is notable on account of its great weight and from the fact that it is, we believe, the only four-track swing span of any size in this country. Its general elevation and plan with dimensions were given in our issue of June 15 and details of the turntables and one of the trusses are shown on our inset sheet this week, as before stated.

The swing span consists of three parallel trusses 389 ft. long, c. to c. of end pins, and 26 ft. apart in the clear, resting on a rim-bearing turntable. The trusses are a combination of the Pratt type and the subdivided panel type so commonly used in long spans in this country, with an inclined top chord. The side trusses and middle truss are identical except in respect to the inclinations of the three middle panel members, which were necessarily different in order to bring the inner ends of each truss directly over the wheels of the turntable. This arrangement is made clear in the elevations in Fig. 1. The strains in each truss must be conveyed to the turntable at a panel point for obvious reasons. It is also essential that these panel points be so located that the strains are carried to the drum track by the most direct route, or, in other words, that they be as nearly as possible vertically over the drum track. Now, in the present case, the distance between the end pins of each half side truss and the panel point coming over the drum track is greater than the distance between the corresponding points of the middle truss. To secure the required conditions then necessitated a modification of the panel spacing in the middle truss, which was made as shown in the drawings. That is, the diagonals, or, as they may be called for convenience, the inner end posts of each half side truss have a less inclination than the same member of the middle truss. This it will be seen brings the lower panel points at the required positions over the drum track, but leaves the upper panel points in the same line transversely.

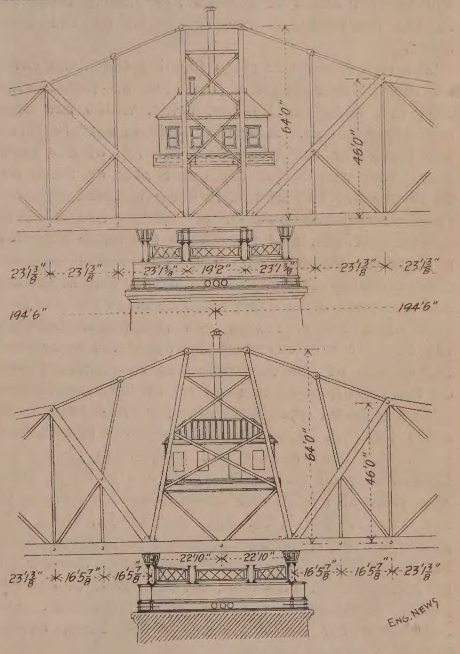


Fig. 1. Arrangement of Truss Members over Turntables.

The trusses are 46 ft. high at the center and 25 ft. high at the ends, and consist of two half trusses with stiff bottom and top chords hung by eyebars to a central tower-like arrangement 64 ft. high. Details of one of the side trusses are shown on the inset sheet. With one exception they present no especial novelties. The unusual feature is the manner of connecting the two parts of the counter-braces in the second and third panels. As will be seen they are riveted together by two splice plates instead of being provided with turnbuckles, as is the usual custom. The top chords of the three trusses are connected by transverse compression members and diagonal ties. The compression members consist of four $3\frac{1}{2} \times 3 \times \frac{3}{8}$-in. angles laced together by $2\frac{1}{2} \times \frac{1}{2}$-in. bars and the diagonals are $5 \times 3\frac{1}{2} \times \frac{3}{8}$-in. angles. The solid floor system renders lateral bracing for the lower chords unnecessary. The arrangement of the portal bracing is shown in the illustration.

The floor system is the New York Central & Hudson River R. R. Co.'s standard solid floor, already illustrated and described in this journal. The troughs are 15 ins. wide and 18 ins. deep. Instead of filling the troughs with concrete and ballast, however, as is usually done with this system of flooring, the rails are to be bolted directly to shims riveted to the troughs. These shims are 8 × 11½ × ½ in. and the rails are clamped to them by beveled clamps and bent bolts. It may be noted also that a vulcanized fiber insulation will be placed between the shim and the rails, so as to permit the use of track circuit signals.

Probably the most interesting part of the span is the turntable. This is somewhat less in diamete than the width of the bridge, and carries two long and two short raising girders, upon which the bottom chords of the trusses rest. The long raising girders run transversely across the turntable and carry the side trusses at their ends and the short raising girders carry the middle truss. These raising girders rest upon distributing girders placed between the two concentric rings of the drum. The distributing girders are placed at the panel points through which the strain in the trusses is carried to the turntable, and, as their name indicates, are for the purpose of distributing the strains to the drum. They consist simply of two short radial girders built between the rings of the drum, and connected by parallel girders, or long distributing girders, as they are called on the drawing. The position and construction of the several kinds of girders are clearly indicated in the drawings of the turntable, on the inset sheet.

The two concentric rings forming the drum carry at the bottom bearing surfaces of rolled steel 12½ ins. wide and 2½ ins. thick, which run upon cast steel wheels. A similar bearing surface forms the track for the wheels on the top of the pivot pier. The wheels for the outer ring or track are 72 in number and 24 ins. in diameter, and 10½ ins. face. The same number of wheels are used on the inner track, and they have the same face but a diameter of only 20½ ins. The wheels are not placed radially opposite each other, but alternate, and are each upon a separate axle. They are held stiff by a radial frame and separators between the circular arcs carrying the wheels. The remaining details of the turntable are so clearly shown on the drawings as to need no further description.

The general specifications for the bridge require that all material shall be acid open-hearth steel. All bent angles and connection plates are to be annealed and all castings are to be of steel. The general design for the bridge was made by Mr. Walter Katte, M. Am. Soc. C. E., Chief Engineer of the New York Central & Hudson River R. R., and the structural details were worked out by Mr. Geo. H. Thomson, M. Am. Soc. C. E., Engineer of Bridges for the same company. The contractor for the ironwork is the King Bridge Co., of Cleveland, O.

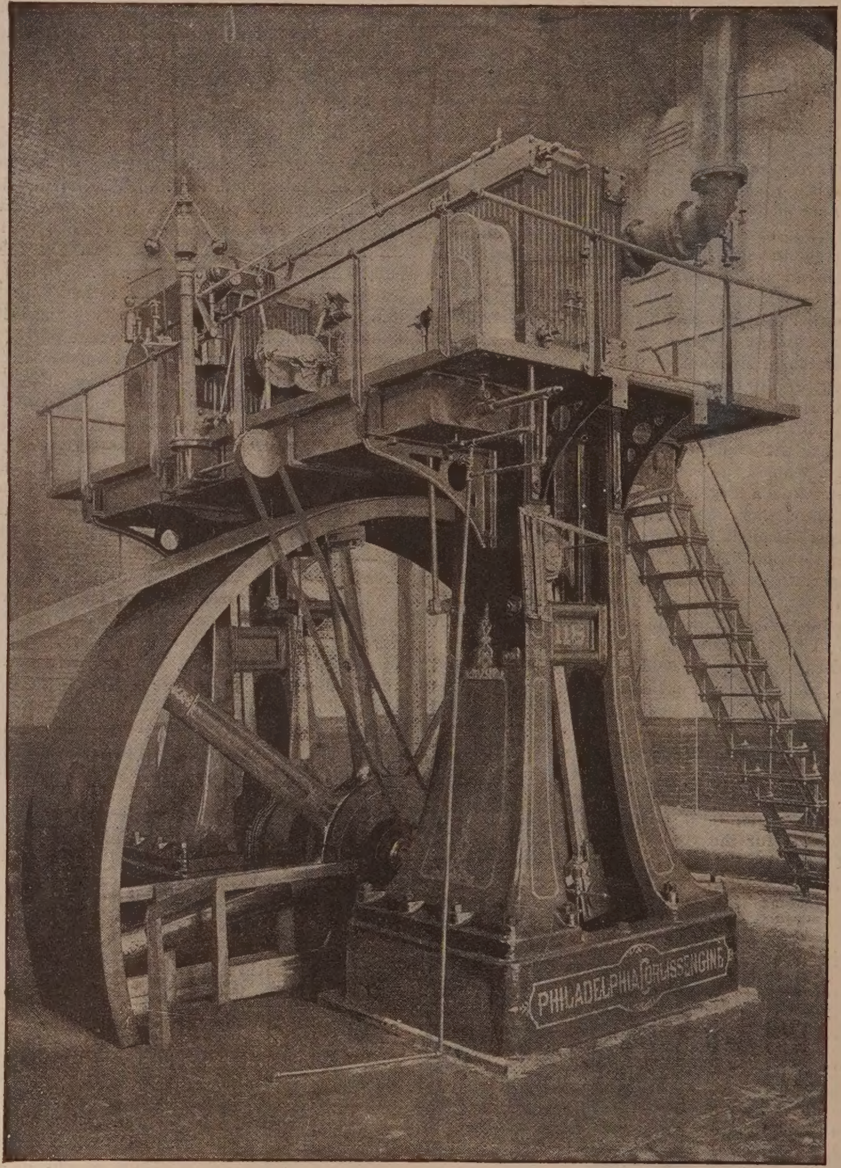
CORONER'S VERDICT REGARDING THE RESERVOIR BREAK AT PORTLAND, ME.

The break in the reservoir of the Portland Water Co. was fully described in our issue of Aug. 17 and further discussed in our issue of Aug. 24. Four persons were killed by the disaster, and the Coroner's Jury recently reported on its cause as follows:

> The jury find that the reservoir was constructed in the years 1888 and 1889; that the Portland Water Co. employed an engineer of long experience and of the highest standing in his profession to make the plans of construction and to supervise from the beginning of operations thereon the work of the contractor engaged in building the reservoir; that the only changes made in the plans from the time of the inception of the work to the day of the completion of said reservoir were in the direction of increased expense and efficiency; that the contractor who built the reservoir was a man of experience in such work, and that the work of construction was done pursuant of the plans of the engineer, and in a thorough and workmanlike manner.
>
> From the evidence submitted by the engineers, the jury are unable to determine the precise cause of the accident, but feel satisfied that it was in some way connected with the overflow pipe, which pipe was an ordinary straight 12-in. iron pipe, similar to pipes used for water mains, laid on a slope through the earthen embankment of the reservoir, surrounded with rammed puddling material.
>
> And the jury believe that the presence of said iron pipe laid through said embankment in the manner aforesaid was the weak place in the embankment of said reservoir, and that the presence of such a pipe without adequate collars or cut-off walls, laid in manner aforesaid, was a source of danger and was not consistent with the high degree of safety which the public have a right to expect in construction of reservoirs located within the limits of a city.

THE PHILADELPHIA ENGINEERING WORKS VERTICAL CORLISS ENGINE.

We illustrate herewith a vertical cross-compound engine with Corliss valve gear, built by the Philadelphia Engineering Works for the Hudson Electric Light & Power Company's station at Hoboken, N. J. The station contains two engines of this class which have been doing daily service since the first of the year, and are reported to be showing excellent results in economy of fuel, so good that the managers of the Hoboken company have decided to order a third engine, double the size of the two now in use, when an increase of capacity becomes necessary.



VERTICAL CORLISS ENGINE IN STATION OF HUDSON ELECTRIC LIGHT & POWER CO., HOBOKEN, N. J.

The engines illustrated are nominally of 500 HP. each, but will readily indicate 800 HP. when using the 125-lb. steam which the boiler plant of this station supplies. The principal dimensions are: High-pressure cylinder, 20 ins.; low-pressure, 36 ins.; stroke, 36 ins.; revolutions per minute, 103 (= 618 ft. per minute piston speed). The main shaft bearings are 12 × 24 ins. The shaft is 14 ins. diameter at the flywheel seat. The flywheel is 17½ ft. diameter and 54 ins. face and weighs 47,000 lbs.

In the Hoboken station power is transmitted from the flywheel to a countershaft by belting running at a speed of 5,660 ft. per minute, and the dynamos for the various circuits are driven from pulleys on the countershaft.

As already stated, Corliss valve gear is used. A counterweighted governor of the Porter type controls the liberating gear on the high-pressure cylinder and is stated to give very good regulation. It will be noted that the number of revolutions is quite high for an engine with releasing valve gear, and this, of course, helps in the governing. The steam and exhaust ports have a generous area.

In passing from the high-pressure to the low-pressure cylinder, the steam goes through a reheating receiver located beneath the platform, but no steam jackets are used on either cylinder. The makers of the engine believe that if the steam is thoroughly reheated between the cylinders, steam jacketing is of no benefit with engines of high rotative speed, and especially with four-valve engines which admit and exhaust the steam through separate ports, thus avoiding the loss of heat due to extended surface of the ports.

It will be noticed that the engine illustrated is not unlike the vertical direct-connected type of engine which is so rapidly growing in favor for large power stations. We understand that the Philadelphia Engineering Co. proposes soon to place on the market a vertical engine suitable in the larger sizes for direct connection to multipolar generators. Its speed will be from 125 to 150 revolutions per minute, according to the size, and it will be fitted with releasing valve gear.

AN ARCHED PIPE BRIDGE AND 34 AND 30-IN. BY-PASS CONNECTION; CITIZENS' WATER CO., DENVER, COLO.

By W. F. Allen.

The Citizens' Water Co., of Denver, Colo., has for some months been engaged in the construction of a wood conduit 23 miles long; the head is located on the Platte River, in Platte Canyon, about two miles from its mouth. On this line are several novel and interesting pieces of work, including a pipe arch or bridge located about 1½ miles from the head, shown by the views, Figs. 1 and 2.

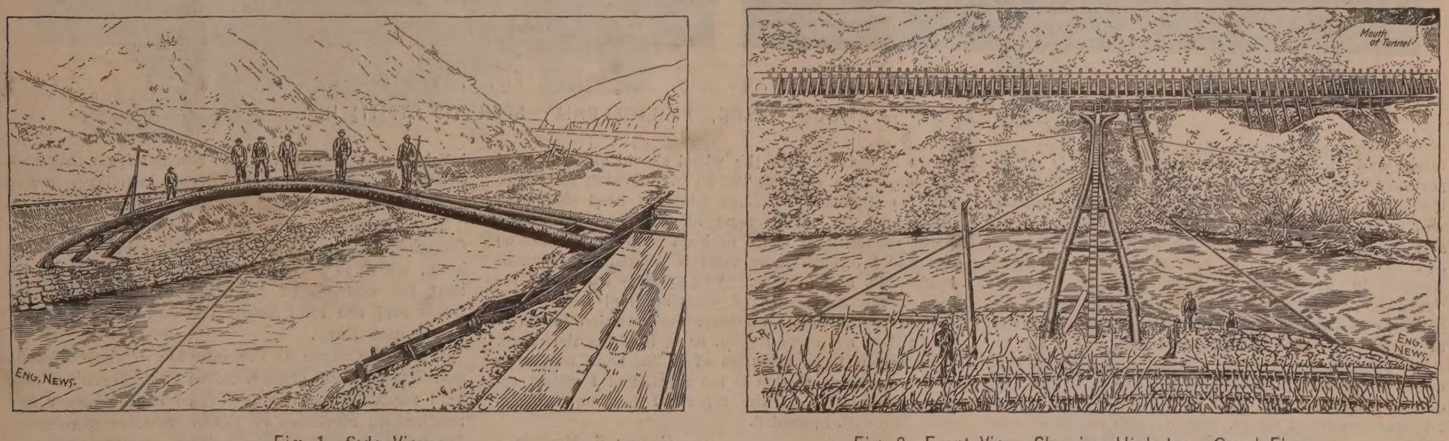
Owing to the difficulties which would be experienced in placing a pipe under the bed of the stream at this point, it was thought best to span the river with a pipe arch, composed of two 12-in. wood pipes, the chord length of which is 103.5 ft. with a middle ordinate of 9.85 ft.

The construction of this pipe is identical with that used by the above company in all its conduit lines, it being built of staves milled from 2 × 4-in. Texas yellow pine, which when finished are 1½ ins. thick. The pipe for the bridges is banded with ⅜-in. steel bands 2½ ins. c. to c.

The water which passes through this arch is taken from the high line canal flume and dischanged into a 30-in. main, which extends from the buttress of the arch to the filtering plant, a distance of about three miles. The skewbacks or abutments of the arch were made by using two 30 x 12-in. T's on the lower end and two 20 x 12-in. L's on the upper end. These T's and L's were imbedded in concrete, which was re-enforced by building in steel rods.

On top of the 20 × 12-in. L's and parallel to the high line canal flume, was built a 2 × 3-ft. flume, between which and the large flume are three 12-in. pipe connections with the necessary gate attachments to regulate the flow of water.

The pipe arch was built on falsework erected on the ice during the winter. The two pipes start from the skewbacks at points 12 ft. apart, and gradually converge until they meet at the crown of the arch. Between the pipes at each end are placed three timber braces about 10 ft. apart, with bands around the pipe, and rods with turnbuckles, which brings everything up tight and solid, making the arch very stiff and rigid horizontally. Four steel cables with proper anchorage are also used as additional security against wind pressure, there being at times very heavy gales experienced in the locality.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Mouth of Tunnel
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Fig. 1. Side View.

Fig. 2. Front View, Showing High Line Canal Flume.

ARCHED WOOD PIPE BRIDGE ON SUPPLY CONDUIT OF CITIZEN'S WATER CO. OF DENVER, COLO.; CHAS. P. ALLEN, CHIEF ENGINEER.

The flume which at present supplies the 12-in. pipes will be abandoned in the near future, and an additional pipe arch will extend from the 20 × 12-in. L's over the high line canal flume to the mouth of the 600-ft. tunnel, at the upper right hand corner of Fig. 2. This will give an additional head of 25 ft. Under the present head the pipes are discharging 10,000,000 gallons of water.

Fig. 3 shows a by-pass connection between the 30 and 34-in. conduits of the company, which cross each other at Wynetha, about ten miles from the city.

These castings, after being connected and ready for lowering, as shown in the view, weighed about 40 tons. A timber frame was erected over them and long lowering screws attached by means of iron bands around the pipe, after which the trench was excavated ready for lowering the connection into place. It was necessary to do the work in this manner in order to avoid shutting off for any great length of time the 30-in. main supplying the city. When everything was ready for lowering, water was shut off, about 5 p. m., the old main cut out, the by-pass lowered to place, the connection made, and water turned on in 24 hours from time of closing off.

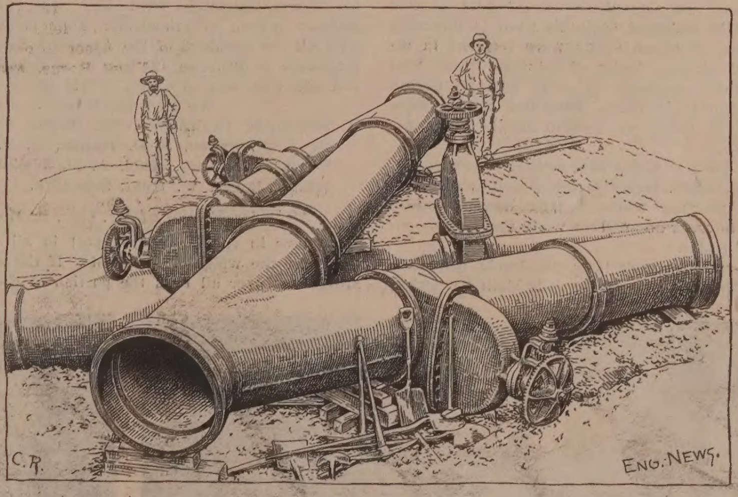


FIG. 3. VIEW OF 34 AND 30-IN. BY-PASS CONNECTION; CITIZEN'S WATER CO., DENVER, COLO.

It can be readily seen, how by manipulating the valves the flow of water can be by-passed or diverted from one conduit to the other. The size of the pipe is hardly distinguishable in the view, but the 30-in.pipe crosses over the 34-in. Mr. Charles P. Allen is chief engineer of the Citizens' Water Co.

REPORT OF THE AM. SOC. C. E. COMMITTEE ON STANDARD RAIL SECTIONS.

The following is the complete text of the report of the Am. Soc. C. E. Committee on Standard Rail Sections, as presented with the sections at the Am. Soc. C. E. business meeting held during the late Engineering Congress, at Chicago. The sections themselves were published full size in our issue of Aug. 17, 1893. At that time the report of the committee had only been approved by the quorum thereof present at its final meeting. It has since been signed and approved by all the members, so that the report is unanimous with the sole exception of the subjoined dissenting opinion by Mr. Geo. S. Morison, in regard to one detail only of the sections above 80 lbs. only. In respect to that detail, the real issue, as we understand it, lies only as to the proper balance between two opposing considerations. It is admitted by all, so far as we know, that other things being equal, it is desirable to have the heads of rails as nearly of one width as possible. It is also admitted by all, we believe, that other things being equal, a thin and wide head is likely to give a better rail than a narrow and deep one. Mr. Morison takes the position that the latter consideration should give way to the former on the sections above 80 lbs.; the rest of the committee held to the contrary opinion.

Final Report of the Am. Soc. C. E. Committee on Standard Rail Sections.

To the President and Members of the American Society of Civil Engineers:

Your Committee on Standard Rail Sections have the honor to submit the accompanying series of rail sections and the following report as their final recommendation, and ask to be discharged.

Since the progress report of the committee, which was presented and accepted at the annual meeting of the Society, Jan. 21, 1891, your committee have held a number of meetings, and conducted an extensive correspondence with many of the chief engineers of the railroad systems of the country.

The carefully prepared reports of the Committee of the Society on "The Proper Relation to Each Other of the Sections of Railway Wheels and Rails," and the papers and discussions of the Society called forth by them gave your committee valuable data as the basis of their work. The first result of their deliberations was the preparation and discussion of several series of rail sections. As will be seen by reference to the progress report there were originally considerable differences in the views of the several

members. **Correspondence, observation of the results** obtained from rails in actual use and discussion have reconciled these differences so that your committee are able to present a final report.

As the mileage of practically straight track so much exceeds that on curves it seemed wisdom to select sections which would give the most satisfactory results on the greater percentage—if at the same time such service would extend to curved track, so much the better. We are satisfied that the sections recommended are the best for straight track, and that if the rails are properly laid they will do well on curves.

Our investigation developed that the greatest difference of opinion among the railroad engineers of the country as to rail sections was upon the proper radius for the top corners of the rail heads. In the correspondence which we present as an appendix to this report, it will be observed that this point is the most discussed. Most of these letters were received in reply to a final circular letter of inquiry which was sent to the chief engineers of every railroad having 100 miles and over of track. Fifty-five replies were received, and of these we present those giving decided opinions.

In deciding upon a series of sections, your committee have given consideration to the manufacturing details of rail making, while seeking designs whose forms would be best adapted to meet the various requirements of traffic.

To have a smooth track it is absolutely necessary that the surface and line of the rails shall be without lumps and kinks. To obtain such rails it is of importance that the metal in the head and flange of the section should be as nearly balanced as economy will permit, thereby permitting the hot metal in the just rolled rail to cool with the least internal strain, and thus, when cold, to be as nearly as possible straight in all directions, thus avoiding excessive "gagging" in the final cold straightening. The importance of this increases with the amount of metal in the section. We decided upon 42% metal for the head, 21% for the web, and 37% for the flange. The constant factors are: Top radius of head, 12 ins.; top corner radius of head 5-16 ins.; lower corner radius 1-16 in.; corners of flange, 1-16 in.; side radius of web, 12 ins.; top and bottom radii of web, ¼ in.; angles of underside of head and top of flange, 13°.

As the grain of "fineness" of "hot rolled" steel is governed by the work applied to it as its heat decreases, and as we are convinced that the wearing qualities of rails largely depend on the closeness of the grain of the steel in their heads, we have sought to design heads which, so far as permitted by the other proportions of the sections, will be affected to the greatest extent by the pressure or work of the rolls.

One of the difficulties in rail manufacture is obtaining perfect flanges. The amount of metal being much less in the flange edges than elsewhere in the section, it cools more rapidly; hence, if the flange is both wide and thin, difficulty will be experienced in making it fill out to the full designed width, and also in preventing the development of flaws, which, if detected, will condemn the rail as first quality, but which may be so concealed as to escape detection, and exist as a constant menace to the safety of the rail. These considerations influenced us in designing our flange sections.

At the meeting of the committee which was held in the Society's house on Dec. 2, 1892, all of the members present congratulated themselves upon the—to them—satisfactory progress of their labors, and separated, little thinking that before another meeting of the committee could be held the hand of death would be laid upon one of the members of the committee. H. Stanley Goodwin was not present at that meeting, official duties preventing at the last moment, but he telegraphed his views, and later wrote the Secretary of the committee indorsing the committee's proceedings. To know Mr. Goodwin was to respect him; to be thrown intimately with him was to yield the warmer tribute of friendship. Your committee unite with all the members of the American Society of Civil Engineers in deploring the loss of so valued a member, and one who was so useful to his fellow-men.

We have the honor to remain,

G. Bouscaren, Chairman; Virgil Bogue, Foster Crowell, S. M. Felton, J. D. Hawks, E. T. D. Myers, Samuel Rea, Thos. Rodd, A. M. Wellington, F. M. Wilder, Robert W. Hunt, Secretary.

Minority Report of Mr. Geo. S. Morison.

I concur in the foregoing report in all respects except one, the width of the heads. If the same wheels are to run over all rails the portion of the rail which comes in contact with the wheel should always be of the same form. Taking the 80-lb. rail with its 2½-in. head as standard, the same width of head should be maintained for all sections likely to be used. The slight reduction in width of head proposed for the 60 lbs. and intermediate sections is comparatively unobjectionable, and I consented to approve the whole report if the same rate of variation had been maintained for the larger sections; the variation in width would then not exceed ¼ in. or ⅛ in. from the mean. The present large variation of ¼ in. from the mean to the maximum section is too great, and I cannot accept this portion of the report. I present the sections herewith appended.

George S. Morison.

THE CRESHEIM ARCH, PHILADELPHIA, PA.

We illustrate in the accompanying cuts an unusually handsome masonry arch recently constructed by the city of Philadelphia, Pa., to carry a sewer across a deep gorge in Fairmount Park. The arch is also interesting as being the fourth in length of span in the United States, its dimensions compared with those of the other three being as follows:

	Span. Ft.	Rise. Ft.	Radius of crown. Ft.
Cabin John, Washington, D. C	220	57	134
Wheeling, W. Va.......	159	28	125.4
Elyria, Ohio....	150	27	208⅛
Cresheim, Philadelphia, Pa...	116	21.17	90

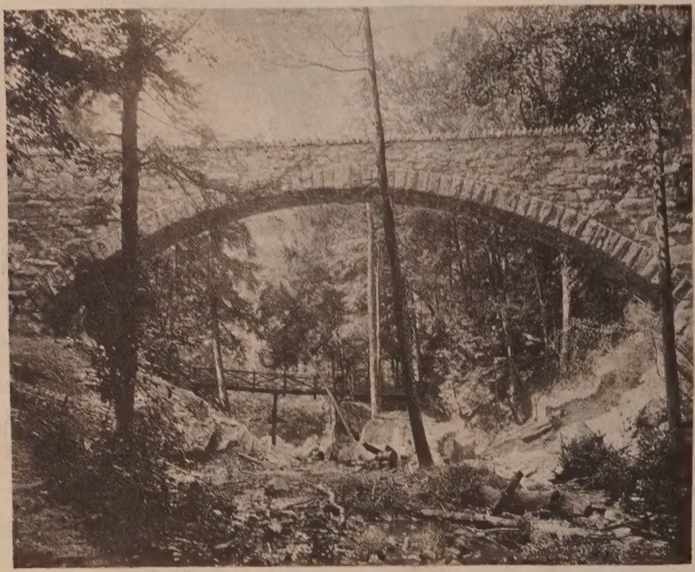


Fig. 1. View of Completed Arch.

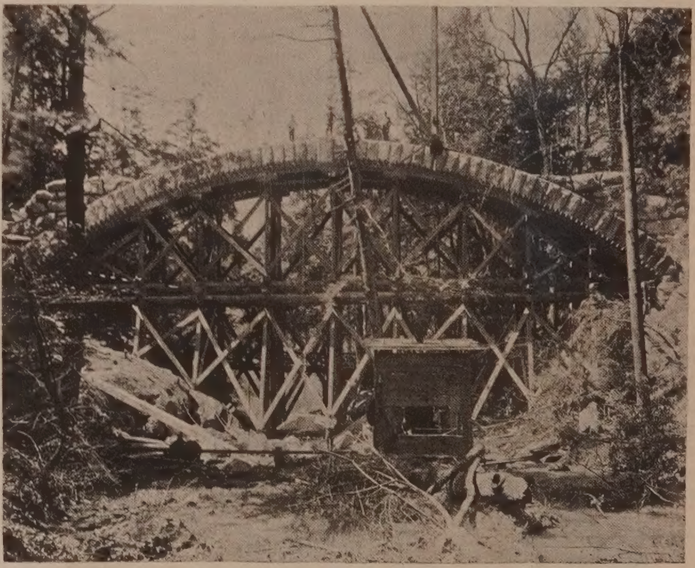


Fig. 2. View Showing Centering.

THE CRESHEIM ARCH, FAIRMOUNT PARK, PHILADELPHIA; SPAN 115 FT. 11½ INS.

To better understand the reasons for the construction of this arch, it is necessary to examine the topography and conditions which exist, and the general scheme for sewerage in this part of Philadelphia. The principal source of water supply for the city is the Schuylkill River and its tributaries. The Schuylkill River joins the Delaware River at the extreme southern end of the city at League Island, and flows through and divides the city, its banks being lined with manufacturies and large railway plants. At one time, these establishments discharged their wastes into the river or tributary streams. An interceptor, discharging through a submerged outlet, was constructed from below the source of supply to the upper end of Manayunk (the Twenty-first Ward of the city), a distance of 6½ miles. Provision was made for a sewage discharge of 1 cu. ft. per 100 acres per second, and roof water excluded, requiring a conduit at the outlet of 4½ ft., with a grade of ½ in. per 100 ft.

A branch of this sewer was carried along Wissahickon Creek at a low level for about one mile. In order to provide for 2½ cu. ft. per 100 acres per second in this area, 1½ cu. ft. of which was for roof and ground water, a sewer 5 ft. in diameter, decreasing to 3 ft. 9 ins., was built from this point about two miles further up the stream, at a high level, so that eventually the sewage from this area can be diverted across the divide into large mains of the combined system running into the Delaware.

Two branches, each two miles in length, drain Germantown and Chestnut Hill; all on the high level, which is peculiarly applicable for the reason that the sources of pollution exist on the high lands and the land below the sewer is a part of Fairmount Park.

When the gorge at the junction of the Cresheim and Wissahickon creeks, called "The Devil's Pool," was reached, the inside bottom of the sewer had reached an elevation of 134.6. Studies were made for bridging with a pipe bridge, suspension bridge and for a viaduct of several spans, but finally, a single-span arch was decided upon and built.

The actual span is 115 ft. 11½ ins., practically 116 ft., with a rise of 21 ft. 2 ins., slightly less than one-fifth the span. The radius of the intrados is 90 ft., with a depth of voussoirs at the key of 3 ft. 6 ins., and at the abutments of 4 ft. 6 ins. The conduit is 50 ft. above the stream, and is 3 ft. 9 ins. in diameter. The arch is 10 ft. in width at the crown, with a batter to the masonry of ½ in. to 1 ft. From the illustration of the completed bridge (Fig. 1) it will be seen that the skewbacks are beds of solid rock.

The voussoirs are of a buff sandstone, from the quarries of Curwensville, Clearfield Co., Pa., and the rubble spandrel walls are of a gray granite from quarries along the Wissahickon Creek. Some of the voussoirs are four and five tons in weight. They are pitched faced and tooled on the beds with joints between of ¼ in.

The masonry was laid in cement mortar. Improved Union, furnished by Lesley & Trinkle, was the brand used. The tests were as follows: 98% passed a No. 50 sieve 2,500 meshes per sq. in. Briquettes of neat cement developed an ultimate tensile strength of 99⅜ lbs. per sq. in. at the end of 24 hours, 147¾ lbs. at the end of seven days, 269 lbs. at the end of one month, and 312 lbs. at the end of three months. The Portland cements which were used for pointing gave results as follows: Germania, 100% passed through a No. 50 sieve; briquettes of neat cement withstood a strain of 373 lbs. in seven days; Giant, 313 lbs. in seven days, and 350 lbs. in one month, 99.7% passing a No. 50 sieve. All the cements were quick setting.

The falseworks and centering for the arch were of the simplest and most effective kind, as shown by Fig. 2. Material was delivered from Wissahickon Drive, across the creek on a tram railway. After the centers were placed, the crown was loaded, the spandrel masonry placed on the haunches and the derricks placed over the haunches, before the key was laid. After the key was set, the centers were slackened by driving the wedges, which were placed at right angles to the length of the arch at intervals of 11 ft. 6 ins. The centers were lowered about ½ in. at a time to allow the joints to get an even pressure, and in about six weeks were entirely removed. The centering was crowned 1 in., and since removal the settlement below the established height has been 2.3 ins. The bottom of the sewer, which has a grade of 3 ins. per 100 ft., was not laid until after the settlement.

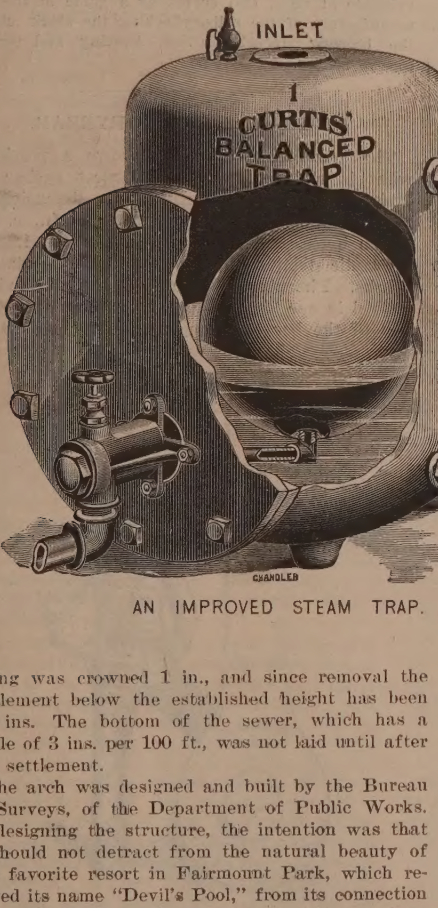
The arch was designed and built by the Bureau of Surveys, of the Department of Public Works. In designing the structure, the intention was that it should not detract from the natural beauty of this favorite resort in Fairmount Park, which received its name "Devil's Pool," from its connection with the Battle of Germantown, as it was here that the extreme right of Washington's army rested, and a bloody skirmish ensued. This spot has become a favorite theme for artists, and has been pictured in some celebrated paintings.

The work of construction was completed in September, 1892. The contractors were McCourt & Laverty, of Philadelphia, who built, besides the bridge 140 ft. in length, 100 ft. of sewer with an average of 18 ft. depth of masonry foundation, at a cost to the city of $15,875. The inspection of the structure after nearly a year of use, shows no cracking nor scaling, either of the cement on the top of the conduit or of the pointing. The illustrations will give an idea of the strength of the skewbacks, upon which the arch rests, with which the observer is particularly impressed in viewing the structure.

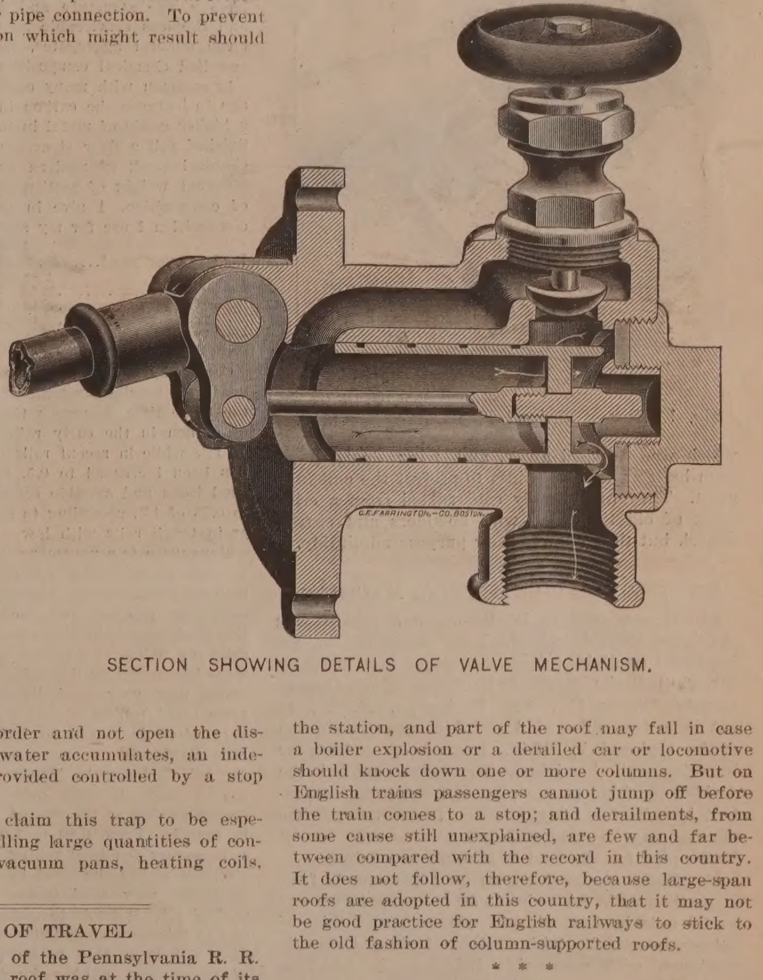
We are indebted to Mr. James H. Windrim, Director of the Department of Public Works, and Mr. George S. Webster, Assoc. M. Am. Soc. C. E., Chief Engineer of the Bureau of Surveys, for the matter from which this description and the accompanying illustrations have been prepared.

A RECENT IMPROVEMENT IN STEAM TRAPS.

We illustrate herewith the latest pattern of steam traps put on the market by the D'Este & Seeley Co., of Boston. As seen by the drawings, the valve is attached to a heavy plate which is bolted to the body of the trap. Should the float require repairs, the bolts holding this plate to the trap may be taken out and the plate with valve and float attached then comes away in one piece, without disturbing the body of the trap or breaking its connection to the piping. The float is made seamless by a new process by which the copper is electrically deposited on the ball while it is constantly rotated, thus securing an absolutely uniform thickness. It will withstand a pressure of 200 lbs. per sq. in. The valve seats against a removable disk of Jenkins packing and can be removed for examination or repair by merely unscrewing the nut against which it seats and taking out the bolt in its center. Thus, the seat may be renewed and the valve itself removed, turned up if necessary, and replaced without loosening a single gasket or pipe connection. To prevent the serious interruption which might result should the trap get out of order and not open the discharge valve as the water accumulates, an independent by-pass is provided controlled by a stop valve, as shown.



AN IMPROVED STEAM TRAP.



SECTION SHOWING DETAILS OF VALVE MECHANISM.

The manufacturers claim this trap to be especially adapted to handling large quantities of condensed water from vacuum pans, heating coils, drying-rooms, etc.

NOTES OF TRAVEL

The great trainshed of the Pennsylvania R. R. at Jersey City, whose roof was at the time of its completion, two years ago, the largest single span roof in the world, save the Machinery Hall of the Paris Exhibition, is a piece of work of which its designers may well be proud—in dry weather. But when it rains the fact must be chronicled that the roof falls very far short of the purpose for which it was designed. An expert might be able to decide that it rained more outside than inside, but the ordinary man, making no pretentions to the abilities of a rain gage, might conclude from the size of the drops that more rain was falling underneath the roof than from the skies. The fault seems to be chiefly with the glazing, although in a driving storm a good deal of rain enters between the slats of the ventilators.

As so many large span buildings with glazed roofs are being erected nowadays, it seems worth while to call attention to the importance of selecting a watertight system of glazing, if there is such a thing on the market. It is well known that ordinary glazed roofs are prone to leak. The roofs of the World's Fair buildings gave a great deal of trouble by leakage when they were first erected, and it was only by a large expenditure of time and money in going over them and stopping the holes and cracks that they were finally made fairly tight.

* * *

Speaking of large-span trainsheds recalls the remark of an English engineer when looking at the model of one of the large German trainsheds exhibited in the Transportation Building, at the Columbian Exposition. "Stupid pieces of work—these great span-roofs at your railway stations," was his comment, and he went on to explain that in England no more large-span trainsheds have been built since the St. Pancras, and to claim that the roof supported by columns was just as good a structure, and much more economical. Is this so or not? The question is one which many railway officers will be called on to decide during the next few years, and it is one on which considerable may be fairly said on both sides. The argument against columns in trainsheds is that they are dangerous to passengers jumping off trains entering the station, and part of the roof may fall in case a boiler explosion or a derailed car or locomotive should knock down one or more columns. But on English trains passengers cannot jump off before the train comes to a stop; and derailments, from some cause still unexplained, are few and far between compared with the record in this country. It does not follow, therefore, because large-span roofs are adopted in this country, that it may not be good practice for English railways to stick to the old fashion of column-supported roofs.

* * *

The tunnel of the Cataract Construction Co. at Niagara Falls has recently been put in use, to a limited extent, through the starting of the large mills of the Niagara Falls Paper Co., whose turbines, generating about 5,000 HP., discharge their water into a small tunnel, which empties into the main tail race tunnel. Work on the wheel pits for the main power works is steadily in progress, about 300 men being employed, but it will probably be nearly a year longer before the entire work is completed and ready for the delivery of power. The massive cut-stone masonry lining the mouth of the wheel pits and separating the entry channels from each other is a class of work which cannot be hurried. Any engineer who visits Niagara

Falls on his way to Chicago will find it well worth his while to inspect the work and see for himself the size of the plant which is being laid down here for the greatest power development scheme ever undertaken.

* * *

The four years which have elapsed since the Johnstown flood have sufficed for the rebuilding of most of the towns which suffered in that disaster; but the channel of the Conemaugh River from South Fork to Johnstown bears indelible record of the force of the torrents which swept down it in the early summer of 1889. The deep erosion of the banks, where the flood swept through narrow channels, and the scattered bowlders, tree trunks and broad stretches of pebbly gravel, where the bluffs widened and allowed the current to drop its heavier burdens, are eloquent witness to the size of the stream which for a brief half hour poured down the valley. The present stream, even at high water, looks like a puny creek traversing the bed of a river as it meanders in winding course over these broad gravel reaches. Its force and volume, however, are still somewhat threatening to portions of the roadbed which the Pennsylvania R. R. built down the valley to replace that which was washed away, and wing dams have been built at various points to protect the embankment. They are cheaply constructed from a cribwork of old ties filled with bowlders and coarse gravel, but they answer their purpose admirably.

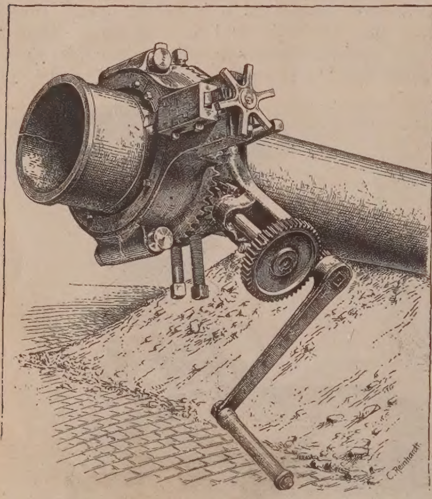


Fig. 1. View of Divided Pipe Cutting Machine.

THE DIVIDED PIPE CUTTING MACHINE.

In our issue of May 18, 1893, a new pipe cutting machine was described. This machine, in its improved or divided form, has since been used by Mr. F. S. Pecke, Engineer in Charge of the Queens County Water Co., Far Rockaway, N. Y., to cut some two miles of 6 and 8-in. pipe which was to be replaced by 12-in. Instead of melting or breaking out the joints, Mr. Pecke applied the divided machine to the pipe and cut it in convenient lengths for relaying. For the latter purpose sleeves may be employed and grooves may be cut in the pipe for the lead in making new joints.

Mr. Pecke states that two men have made from 15 to 20 cuts in 8-in. pipe in 10 hours and as many as 30 cuts in 6-in. pipe in one day, and this, of course, practically without loss of pipe. Ordinary workmen with reasonable judgment in handling tools did the work. This fall Mr. Pecke expects to make five cuts in the trench for the purpose of setting gates.

The illustration in our issue of May 18, 1893, showed a solid machine, which could be used only when one end of the pipe to be cut was free. The accompanying view, Fig. 1, shows the divided machine. Instead of the fixed and revolving collars being in one piece, as formerly, they are now made in two halves, each half being applied to the pipe separately and then bolted together at the flanges, as shown in Fig. 1. The stationary collar, with the crank and gearing attached, is first firmly fastened to the pipe by means of set screws, after which the revolving collar, with the cutting knife, is put in place. The knife is fed by the star wheel, one arm of which strikes the round pin at the left of the large cog wheel at each revolution, thus lowering the knife.

A longitudinal section of the machine is shown by Fig. 2. The device was invented by Mr. D. W. French, Deputy Superintendent of the Hackensack Water Co., of Hoboken, and Mr. Benj. C. Smith, 275 Pearl St., New York, is its selling agent.

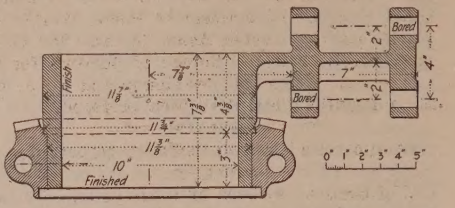


Fig. 2. Longitudinal Section through Pipe Cutting Machine.

STEEL RAILS: THEIR MANUFACTURE AND SERVICE.

The many years of experience with steel rails have clearly demonstrated that those which flow the least under the wheel pressure give the most service, and those that flow the most wear and abrade with the greatest rapidity. This same remark applies to the flange abrasion on curves. The most serviceable rails have a fine structure and small mineral aggregates, and the less serviceable have a coarse structure and large mineral aggregates, though in many cases the so-called chemical composition is identical.

In common with many others I proposed some years ago to increase the carbon in the rails and start with a higher grade of metal in the ingots to obtain in the finished rail a finer structure with the much less mechanical work of modern processes of rolling. Each different weight of section requires a slight difference of composition. I give in tabular form the chemical composition I use for my section:

	Lbs.	Lbs.	Lbs.
Weights per yard....	60, 65 and 70	75 and 80	100
	Per cent.	Per cent.	Per cent.
Carbon	.45 to .55	.50 to .60	.65 to .75
Manganese............	.80 to 1.00	.80 to 1.00	.80 to 1.00
Silicon................	.10 to .15	.10 to .15	0.10 to .15
Phosphorus } Not to	.06	.06	.06
Sulphur.... } exceed	.07	.07	.07

Carbon by itself up to or over 1% increases the hardness and tensile strength of the iron rapidly and at the same time decreases the elongation. The amount of carbon in the early rails ranged from 0.25 to 0.5 of 1%, while in recent rails and very heavy sections it has been increased to 0.5, 0.6 and 0.75 of 1%. With good irons and suitable sections it can run from 0.55 to 0.75 of 1%, according to the section, and obtain fine grain tough rails with low phosphorus.

Manganese is a necessary ingredient in the first place to take up the oxide of iron formed in the bath of molten metal during the blow. It also is of great assistance to check red shortness of the ingots during the first passes in the blooming train. In the early rails 0.4 to 0.5 of 1% was sufficient when the ingots were hammered or the reductions in the passes in the trains were very much lighter than to-day. With the more rapid rolling of recent years, the manganese is very often increased to 1.25 to 1.5%. It makes the rails hard with a coarse crystallization and with a decided tendency to brittleness. Rails high in manganese seem to flow quite easily, especially under severe service or the use of sand, and oxidize rapidly in tunnels. From 0.80 to 1.00% seems to be all that is necessary for good rolling at the present time.

Silicon makes the steel lie very quiet in the molds, producing very solid ingots when present in 0.1 to 0.25 of 1%. It tends to make the crystallization small and in this way contributes to good wear. Some mills have not been able to increase the silicon over 0.1 of 1% without making the steel brittle, while others can run as high as 0.3 of 1% and the rails increase in toughness.

Sulphur and phosphorus are two impurities which are very objectionable. Sulphur makes the steel red short, liable to crack in rolling and checking the welding of the blowholes and pipes. The limit of sulphur is now specified from 0.07 to 0.12 of 1%; the difference between the lower and upper limit will increase the number of seamy heads in the rails, oftentimes in my experience doubling the percentage of seconds on account of the seamy heads. Rails with 0.5 to 0.55% of carbon, 0.07% in phosphorus and 0.12% in sulphur do not seem to be brittle under the drop test, but very tough, as a rule, when rolled in my sections. A seamy head in a rail is not to be desired, though the seams may not be over 1-32 to 1-16 in. in depth. Flow of metal can occur from a seam under the wheel pressures much easier than from a solid head. Phosphorus increases the size of the crystallization, and makes the metal brittle and liable to break in cold weather. The percentage now allowed in rails ranges from 0.06 to 0.11 of 1%.

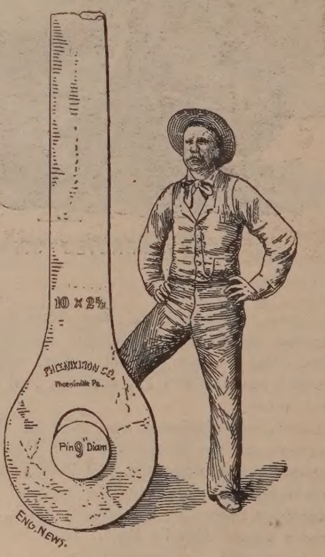
In 1890 I introduced a series of rail sections of different weights, especially designed to produce a tough, fine structure in the heads by the modern process of rolling; also a special 95-lb. rail for the Boston & Albany. It was long ago observed that as the weight of the section increased, the difficulties of producing a fine structure in the head were also increased. In order to secure a fine structure in my large sections, especially the Boston & Albany 95-lb., I proposed the following composition:

	Per cent.
Carbon..	.60
Manganese....	.80 to .90
Silicon........	.10 to .15
Phosphorus not to exceed.................	.06
Sulphur not to exceed.....................	.07

While great doubt was expressed as to the possibility of securing toughness with so high carbon, we were able to control the condition of the metal in the final product of the rails, so that they were of unexpected toughness. The butts stood a drop test of 2,000 lbs. falling 20 ft., and rarely broke, while hundreds stood 2 to 4 blows of 30 ft. before failing, supports 4 ft. apart. The drop test is the most valuable of any yet proposed to test the toughness of the rails. Spacing the butt for 6 ins. before testing makes out of the drop a testing machine unequaled in efficiency and rapidity for rail sections. The information is valuable at once, and serves as a guide in the daily manufacture of the rails, checking the stock mixture, the blowing, recarbonization, heating and temperature of rolling.

TEST OF A LARGE EYEBAR.

The accompanying sketch shows a portion of what is claimed to be the largest eyebar ever broken in a testing machine. Its dimensions before breaking were 10 × 2⅝ ins. × 50 ft., c. to c. of pin holes, and it was broken on the 1,200-ton hydraulic testing machine of the Phoenix Iron Works, Phoenixville, Pa., illustrated and described in our issue of Jan. 10, 1891. The elongation of the bar in a length of 47 ft. was 9 ft. 9 ins., or 20.47%, and the reduction of area was 50.4%. The elastic limit was 33,250 lbs. per sq. in., and the ultimate tensile strength of the bar was 1,626,322 lbs., or 61,720 lbs. per sq. in. The fracture was silky, half cup and half angular, showing no crystalline whatever. A noticeable point brought out by the engraving is the great elongation of the pin hole. This was 2 5-16 ins. It may be stated that the above company is prepared to do all kinds of heavy testing, a separate corps of experts being in charge of the work.


10 × 2⅝
PHOENIX IRON CO.
Phoenixville Pa.
Pin 9" Diam
ENG. NEWS.

Sketch Showing Elongation of Pin Hole in 50-ft. Eyebar Manufactured and Tested by the Phœnix Iron Co.

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* Abstract of a paper read before the New England Roadmasters' Association by Mr. P. H. Dudley.

PERSONALS.

Mr. B. R. Dunn, Engineer of Roadway, of the Wilmington & Weldon R. R., died at Glen Lyn, Va., recently.

Mr. Thomas McLean, of New York city, has been appointed General Manager of the Citizens' St. R. R. Co., of Cincinnati.

Mr. Robert Moore, M. Am. Soc. C. E., has resigned his position as Chief Engineer of the Merchants' Bridge & Terminal Co., of St. Louis.

Mr. E. P. Lord, formerly Superintendent of Motive Power of the Cleveland, Cincinnati, Chicago & St. Louis Ry., is to become General Manager of the H. K. Porter Locomotive Works, at Pittsburg.

Mr. John L. McClure, President of the Moseley Iron Bridge & Roofing Co., of Jersey City, died at Brooklyn, N. Y., Aug. 26, at the age of 79. He had been connected with the Moseley company for 20 years past.

Mr. Joseph Battin, of Elizabeth, N. J., an inventor of some note, died on Aug. 29, at the age of eighty-seven. Mr. Battin built the gas works in several large Eastern cities, and made some important inventions in machinery for preparing anthracite for market.

Mr. William A. Chapman, President of the Chapman Derrick & Wrecking Co., died on Aug. 24 from being caught under a falling tree in a storm. Mr. Chapman was born in Brooklyn about 61 years ago, and amassed a fortune as a builder in that city before he organized his well known wrecking company.

Mr. Jos. K. Edgerton, of Fort Wayne, Ind., a pioneer in the early railway development of Indiana, died on Aug. 26 at the age of 75. He was President of the Ft. Wayne & Chicago R. R. in 1855, and was one of the earliest presidents of the Grand Rapids & Indiana R. R. He retired from active business a score of years ago.

Mr. Warren Ackerman, well known to engineers by his long connection with the Lawrence Cement Co., died at his country residence, Hyde Park, near Scotch Plains, N. J., on Aug. 26. Mr. Ackerman was a native of New Brunswick, N. J., and in the early years of his business life he was engaged in the india rubber trade, in which he accumulated a large fortune. Soon after the war he became interested in hydraulic cement manufacture, and the great industry which he built up is so well known to our readers that it need only be mentioned here.

Mr. Joachim G. Giaver, M. Am. Soc. C. E., has formed a partnership with Mr. M. E. K. Lehmann, with the firm name of Giaver & Lehmann, to carry on a general contracting business. Their offices are in the Monadnock Block, Chicago. Mr. Giaver is a graduate of the Technical College, in Throndhjen, Norway. After coming to this country he was employed for one year in the bridge department of the Northern Pacific R. R., and from 1883 to 1890 he was Chief Engineer of the Shiffler Bridge Co., of Pittsburg, in charge of all designing and detail work. In March, 1892, he was appointed Assistant Chief Engineer of the World's Columbian Exposition, and while occupying that position designed the trusses of the Manufacturers and Liberal Arts Building and the dome of the Administration Building.

Mr. Hayward A. Harvey, the inventor of the Harveyized steel armor plate process, died at Orange. N. J., on Aug. 28. Mr. Harvey was born on Jan. 17, 1824, at Jamestown, N. Y., and was the son of Gen. Thomas W. Harvey, a prominent engineer and inventor. The son was first employed in the New York Screw Co. as a draftsman, and in 1852 he connected himself with the Harvey Steel & Iron Co., of Jersey City, of which his father was President. Mr. H. A. Harvey, between 1870 and 1890, filed about 125 patents for various valuable improvements, among the most notable being a process for rolling threads on screws and bolts, and his now famous process for hardening steel armor plates. The first patents for the later process were taken out in 1888, and the first armor plates so treated were turned out in 1890. The Harvey Steel Co., of which Mr. Harvey was President and held the controlling stock, was organized in 1889 with works in Pittsburgh and Newark.

NEW PUBLICATIONS.

SPECIAL REPORT ON RAILWAY PLANT Exhibited at the Paris Exposition. 1889. By Prof. Lewis M. Haupt. Pub. Doc. Pamph., pp. 106; 78 illustrations.

This is a specimen of the promptness with which our Government publishes investigations of technical importance. Professor Haupt's report is, or was, an interesting one; but the world has moved ahead four years since it was prepared. We notice, for example, his lengthy commendation of the tubular frame freight car, which, he says, may be expected to rapidly supersede the wooden car. As a matter of fact, the car has proved a failure in service, and the designers of iron frame cars are now proceeding on entirely different lines.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Report of Proceedings of 26th Annual Convention. Angus Sinclair, Secretary, New York. 8vo. paper, pp. 273. $1.50.

We reported the proceedings of this convention in our issue of June 29 last. The topics on which the discussion was of most value were the economy of compound locomotives and tests of steel firebox plates.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY: A Brief Account of Its Foundation, Character and Equipment, Prepared in connection with the World's Columbian Exposition. Dr. H. W. Tyler, Secretary. 8vo; pp. 39; 21 half-tone engravings.

The text and handsomely executed illustrations of this pamphlet convey a good general idea of the work of the Institute. The work of the hydraulic laboratory and courses were described and illustrated in our issue of June 22, 1893.

CAST IRON PIPE: The Addyston Pipe and Steel Co., Cincinnati, O.

An illustrated pamphlet of ten pages describes cast iron culvert pipe, sewer and street castings, the Addyston reversible road roller and Forster's rock breaker; another pamphlet of six pages describes and illustrates the various styles of cast iron lamp posts made by this firm. Each pamphlet gives the weight of various sizes of cast iron pipe and specials.

ELECTRIC MOTORS.—Siemens & Halske Electric Co. of America, Chicago. 8vo, pamph., pp. 25, 25 illustrations.

This pamphlet describes a new system of transmission of power from an electric motor to a machine, so that the motor can run at constant speed while the machine runs at a speed which may be varied as desired. The illustrations are very poor, much below those issued by American firms of such a standing as Messrs. Siemens & Halske.

MINING MACHINERY.—Chicago Iron Works, Chicago, Ill.

This firm issues a series of five catalogues, devoted respectively to power, hoisting, pumping and carrying machinery, concentrating machinery, milling machinery, smelting machinery, and the J. M. Bryan roller quartz mill. About every class of machinery required in mining operations of any sort is described in these catalogues.

SOCIETY PROCEEDINGS.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The fall excursion of the association will take place on Wednesday, Sept. 13, when Plymouth, Mass., will be visited. The Plymouth Water Board has arranged to give a ride to points of historical interest, and to the pumping station of the water-works. Dinner will be served at the Hotel Pilgrim at 1 p. m., tickets being $1 per plate. R. C. P. Goggeshall, Secretary, New Bedford, Mass.

NEW ENGLAND ROADMASTERS' ASSOCIATION.—The eleventh annual convention was held at the American House, Boston, Mass., Aug. 16 and 17. The proceedings followed closely the program given in our issue of Aug. 3, the most important paper being that by Mr. P. H. Dudley, on "Steel Rails: Their Manufacture and Service," a short abstract of which we give in another column. The following officers were elected for the coming year: President, G. L. R. French; Vice-President, R. P. Collins; Secretary, E. E. Stone; Executive Committee, G. L. R. French, R. P. Collins, E. E. Stone, C. B. Lentell, F. B. Sibley, S. B. Bodwell, Jr., J. W. McManama.

INTERNATIONAL ELECTRICAL CONGRESS.—The sessions of this congress were held at the Art Institute, Chicago, on Aug. 21 to 25 inclusive. Prof. Elisha Gray, chairman of the committee on organization, called the opening session to order and Prof. Elihu Thomson was chosen temporary chairman. The committee on permanent organization reported the names of Dr. H. von Helmholtz as honorary president, and Dr. Elisha Gray as permanent chairman. The technical work of the congress was carried on in sections. Section A, devoted to Pure Theory, had as its chairman, Prof. H. A. Rowland, of Johns Hopkins, and its proceedings would interest few of our readers. Section B, "Theory and Practice," was presided over by Prof. C. R. Cross. The subjects presented included "The Transmission of Electrical Signals through Space," by Prof. W. H. Preece; "Ocean Telephony," by Dr. Silvanus P. Thompson, and papers by several authors on measurements and efficiency of arc lamps.

Prof. Edwin J. Houston was chairman of Section C, devoted to Pure Practice. The most interesting topic discussed was the question, What system is best for transmission of power over long distances? Prof. George Forbes, the consulting electrician of the Cataract Construction Co., said he had recommended the two-phase alternating current system with independent circuits for use at Niagara. All the great electrical firms of the world presented bids and designs for this plant, and those who submitted plans for direct current systems were much higher in price than the others. Among other subjects discussed were the corrosion caused by ground currents and the design of dynamos of very high voltage.

At the concluding session of all sections the report of the Chamber of Delegates was presented fixing the values of various electrical units. The committee appointed to settle on a standard of light for photometric measurements reported that no standard at present proposed was wholly satisfactory, and further investigation was therefore recommended.

The total number in attendance at all sessions of the congress was about 375. The proceedings of the week were varied by a banquet at the Grand Pacific Hotel on Thursday evening, a reception by Prof. W. H. Preece, on behalf of the English Institution of Electrical Engineers, on Saturday, a lecture by Nikola Tesla, and various excursions and entertainments.

AMERICAN WATER-WORKS ASSOCIATION.—The annual meeting of the association will be held at Milwaukee, Sept. 5 to 9. The following papers have been announced: "Analyses of Public Water Supplies, with Suggestions for a More Exact and Uniform System," by Dr. H. Leffmann, Philadelphia; "Municipal Acquirement of Private Water Company Plants, as Illustrated by the Syracuse, N. Y., Condemnation," by S. E. Babcock, Little Falls, N. Y.; "Driven Wells, Supplementary Supply to Brooklyn," by Samuel McElroy, Brooklyn; "Incidents in Water Supply Tests," by J. T. Fanning, Minneapolis, Minn.; "The New Orleans Case," by L. H. Gardner, New Orleans; "Details of Construction of High Earthen Dams for Storage Reservoirs on the Pacific Coast," by L. J. LeConte, Oakland, Cal.; "The Office of City Civil Engineer in Small Cities," by H. F. Dunham, New York City; "Damages for Appropriation of Streams," by P. D. Wanner, Reading, Pa.; "Covered Service Reservoirs," by Samuel Tomlinson, Bombay, India; "The Geology of Wisconsin Water Supplies," by D. W. Mead, Rockford, Ill.; "Is Our Drinking Water Dangerous to Health?" by John W. Hill, Cincinnati, O.; "Some Experience Regarding Deep Wells," by F. A. W. Davis, Indianapolis, Ind. In addition, a paper, the title of which has not been announced, will be presented by Prof. Erastus G. Smith, Beloit, Wis.

COMING TECHNICAL MEETINGS.

ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Sept. 5. Secy., W. Halliburton.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 6. Secy., F. Collingwood. 127 East 23d St., New York.
WESTERN SOCIETY OF ENGINEERS.
Sept. 6. Secy., Jno. W. Weston. 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Sept. 6. Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF MINNEAPOLIS.
Sept. 7. Secy., E. Nexsen, 504 Kasota Block.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Sept. 9. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Sept. 11. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Sept. 11. Secy., M. F. Schinke. City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Sept. 12. Secy., F. C. Osborn, Case Library Bldg.
ROAD MASTERS' ASSOCIATION OF AMERICA.
Sept. 12, 13 and 14. Annual Convention at Chicago, Ill. Secy., W. W. Sharpe, Waycross, Ga.
NORTHWEST RAILROAD CLUB.
Sept. 12. Secy., W. D. Crosman. Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Sept. 12. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
Sept. 12. Secy., F. E. King, Jacobson Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Sept. 13. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Sept 13. Secy. F. M. Curtis. O. C. R. R., Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
Sept. 14. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Sept. 14. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Sept. 15. Secy., D. W. Meeker, St. Paul.
TACOMA SOCIETY OF ENGINEERS AND ARHITECTS.
Sept. 15. 201 Washington Building.
SWEDISH ENGINEERS' CLUB.
Sept. 16. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
WESTERN RAILWAY CLUB.
Sept. 19. Secy., Clement F. Street, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept. 20. Secy., L. V. Carmalt, Roanoke, Va.
COLUMBIAN ENGINEERING SOCIETY.
Sept. 19. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Sept. 19. Secy., R. H. Clark, Pittsburg.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Sept. 20. Secy., S. E. Tinkham, 36 Broomfield St.
NEW YORK RAILROAD CLUB.
Sept. 21. Secy., John A. Hill, Temple Court, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Sept. 21. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Sept. 21. Secy., C. F. Franson, Portland Block.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Sept. 21. Secy., S. A. Charpiot, Macon, Ga.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Sept. 22. Secy., C. H. McLeod, Montreal, P. Q.
CENTRAL RAILWAY CLUB.
Sept. 27. Secy., S. W. Spear, Buffalo, N. Y.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 2. Secy., C. L. Annan, City Engineer's Office.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Oct. 6. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 6. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 7. Secy., L. F. Rondinella, 1122 Girard St.

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AND

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The headquarters of Engineering News on the grounds of the World's Columbian Exposition are at Section K, Aisle 37, of Machinery Hall (central aisle, just west of the large water tank), and at Section U N, Posts 10 to 11 (office No. 9), of the Transportation Building Annex, at the west end of the Great Britain railway exhibit. For the convenience of subscribers and advertisers, it is announced that some member of the editorial staff of this journal may be found at the first-named office, in Machinery Hall, from 10 to 10:25 a. m., of each week day, and from 10:35 to 11 a. m. at the second-named office, in the Transportation Building; as also frequently at other times. Appointments may be made by calling at our downtown Chicago office in the Monadnock Building.

The Engineering headquarters, at Chicago, are at No. 10 Van Buren St., directly opposite the viaduct leading to the Illinois Central R. R. World's Fair trains, and to the steamboat pier, and but a stone's throw from it. The rooms are large and comfortable, and include reading, writing, smoking and other apartments. The rooms are to be kept open during the Fair by subscriptions of engineers, and all American and foreign engineers visiting Chicago are invited to register and make free use of the rooms during their stay, and to have their mail addressed there. An informal reception is held at these rooms every Monday evening from 8 to 10 p. m.

The U. S. Department of Agriculture, through Mr. B. E. Fernow, the chief of the Division of Forestry, is at the present time disseminating more useful and detailed information concerning the character and quantity of the timber supply of the United States than was ever before available. The commercial value of the work already performed by this division and the economy to the country at large can be better understood by the statement that the single demonstration of the real value of "bled" turpentine timber, for building purposes, means an increase in the value of the product of nearly 1,000,000 acres in the Southern States and a saving of $2,000,000 in value with the appreciation in price taken at only $1 per 1,000 ft. of timber. The value of the products derived from our forest resources, says the last report of Mr. Fernow, amounts to more than $1,000,000,000 annually and as a single industry is only surpassed by agriculture itself. But that this vast industry sadly needs fostering care, intelligent attenion and a close study of present demands and future needs and resources is proved by the vast consumption of timber in this country as compared with that of other countries where necessity has formulated and enforced protective laws. According to the census reports of 1890, the annual consumption of wood for all purposes has reached the enormous total of 22,000,000,000 cu. ft. annually, or about 350 cu. ft. per capita, as compared with 12 to 14 cu. ft. per head in Great Britain and 40 cu. ft. for Germany.

The largest amount of this consumption is for firewood, or about 280 cu. ft. per capita; but this wood in the United States comes to a large extent from split body wood of the best class of trees, and not from the inferior material used for this purpose in older countries. The consumption of sawed wood products is over 40 cu. ft. per head; and if to this is added hewn timber and wood used in railway construction the total annual requirements for sizable timber will easily reach 50 cu. ft. per head. To produce such amounts the annual growth of not less than 500,000,000 acres of well-managed forest in good condition would be necessary, and it would more than double this acreage to add the consumption in firewood, mining and fencing, for which we use body wood, hardly inferior to saw timber. According to the most carefully compiled statistics, we now have only about 480,000,000 acres of forest area, and a large part of this is believed to be in a more or less devvastated condition owing to destructive fires and general lack of care. We have, therefore, been using for some time more than our annual growth and are rapidly cutting into our inherited capital account. Even assuming the figure of a present annual consumption of 10,000,000,000 cu. ft., as claimed by some authorities, the supply would be exhausted in less than 100 years, for our consumption has increased at the rate of about 30% in the last three decades.

In considering the destructive agencies at work fire comes first, and the statement is made that if this nuisance could be reduced to unavoidable proportions, half the forestry problem would be solved. Railways are probably responsible for as much loss of timber by fire as any other one cause, and this danger can only be reduced by strictly enforced ordinances regarding the use of spark-arresters, regulations for the cleaning of ashpits and frequent patrols of the lines. But even these precautions would hardly be effective, says Mr. Fernow, without fire-safety strips of land running parallel to the railway and variously utilized. Wherever this system has been adopted and the clearing attended to in the spring, fire from locomotives have been of no significance, as the wooded strips acted as screens and prevented the sparks from passing to the growth beyond the ditch. The company could use these strips for growing their own tie-timber, and in any event owners of valuable timber land should find in this system a hint for self-protection. Against other causes of fire constant watchfulness will alone protect, and in densely wooded communities this protection is best secured by legal enactment similar to the laws passed by the states of Pennsylvania and Maine. The forestry division of the Department of Agriculture, in carefully studying this many sided and evidently most important problem, is doing most excellent work; but unless the public at large extends the facilities of this new department and pays heed to the warnings already issued, little real good will result, and when too late the community will bewail the waste of a noble patrimony in timber lands and find itself compelled to resort to other lands for what we could maintain by a comparatively little intelligent care at the present time.

According to our Philadelphia exchanges, the authorities of that city are making a beginning in a much-needed reform by putting up street signs of steel with the street name in white enamel on a blue ground. Though our item does not state just how they are displayed at the street corners, these signs have the marked advantage of being clean, easily read and lasting. New York is sadly in need of a similar reform, for since the substitution of electric lights for gas on our main thoroughfares, the old glass signs have either wholly disappeared for blocks, or hang in unused wrecks of gas lamps where they can be of little practical use. The citizens as well as strangers need these signs and have a right to demand them of the authorities, and all interests require that they tell the truth and tell it plainly. Every one is doubtless familiar with the vagaries of the old-time lamp sign which was too often made to lie by simply turning the lamp, and something very different is demanded now. The requirements of the sign itself are well met by the enameled form familiar to every one, but the question of where to put this sign is not so easily answered. The following arrangement has at least the merit of simplicity: Where there is an electric lamp, or any other permanent and suitable city fixture at the intersection of streets, bolt firmly to this fixture a right angle of cast iron carrying on its two faces the proper street names in white on blue enamel. Where there is no corner street fixture, fix the same sign upon the corner house, even if it has to be placed midway of the second story and above the awnings, etc., too often obstructing these corners. The main points to be considered should be the permanent nature of the sign and plainness of lettering, both secured by the heavy casting and the enamel, and permanence of attachment, so that the sign always points in the proper direction. Judging from the unsatisfactory nature of street signs in our large cities generally, a small fortune awaits the man who will invent a sign that will meet the above requirements and yet be cheap enough to satisfy the economical ideas of our city fathers.

A plan for marketing city bonds at a good price, and at the same time drawing the currency which has been hoarded during the past few months back into circulation, is proposed by Mayor Pingree, of Detroit. He advocates the issue of city bonds in small denominations, say, $25 each, and selling them direct to the people, holding that they will have a confidence in such investments that they do not have in savings banks, and will invest their money instead of keeping it in hiding. Doubtless the bonds would be sold chiefly to residents of the city issuing them, and there would thus be a further gain in that a large number of workingmen would have an additional incentive to use their influence for honest and economical city government and for the maintenance of law and order.

In our report of the test of the Allis pumping engines at the Harrison St. station, Chicago, in our last issue, we stated that the feedwater consumption, 12.13 lbs. per I. HP., was one of the lowest ever made, with a steam engine of any type. We have since then noticed that the Milwaukee pumping engine, by the same builders, which was tested by Prof. R. C. Carpenter in March last, showed a consumption of only 11.678 lbs. of dry steam per I. HP. The Milwaukee engine is nearly identical in size and we believe also in general design with the Chicago engines, but it was run in the tests at a somewhat higher piston speed. We would also correct our reference to Mr. Jas. N. Warrington, the engineer who conducted the test, as a member of the staff of the R. W. Hunt testing bureau. Mr. Warrington is connected with the Vulcan Iron Works, of Chicago. The test was made jointly by one of the engineers representing the Hunt bureau and Mr. Warrington.

A representative of our staff has been examining the register of foreign engineers and those interested in engineering visiting the headquarters in Chicago. To the present date 303 foreigners have so registered, and of this number 166 are from Germany, England sends 30, and France 27. Of other countries represented by engineers we note Italy, Russia, Norway, Sweden, Spain, Japan and Australia. Space forbids giving the list in full, and some of the names are so illegibly written that they defy translation into cold type. The majority of the German engineers belong to the German Society of Civil Engineers and the Society of Mechanical Engineers; and many of the other foreign engineers are attached to the official commissions representing their several governments.

SHALL OUR STREAMS AND LAKES BE RESERVED FOR WATER SUPPLIES OR ABANDONED TO SEWAGE POLLUTION?

The gross sewage pollution to which many of our public water supplies are subjected gives rise to the question, Which shall take precedence, the use of our inland waters as convenient outlets for sewers or as sources of pure water supply?

In considering this question such streams or lakes as are already polluted and are not used as water supplies may be excluded and also such others as pass through densely populated regions and are subject to contamination from street drainage and seepage from polluted soil, even though sewage should be excluded from them. There will remain lakes and streams which were taken for public water supplies when of comparative purity but which later have actually been polluted or are threatened with pollution from the sewage of towns.

Cities whose water supplies are contaminated or threatened with contamination may be divided into two general classes; those which pollute their own supplies and those whose supplies are polluted by other communities. The cities of the first class have only themselves to blame, and deserve no pity except in so far as the natural conditions are such that the removal of contamination or the securing of a new and pure supply involves a great financial burden, which, of course, is no excuse, as a pure water supply should take precedence of other improvements and with all the possibilities of modern sanitary engineering can always be secured.

Cities which, at great expense, have secured water supplies of good quality and gradually find the water deteriorating through sewage pollution from another city deserve sympathy and, as a general statement, should have recourse to legal protection.

It would be interesting to review the laws of the various states of the Union on this point, but for the present we will only touch upon the statutes of three states which seem in advance of all others in this respect. These three states, Massachusetts, New York and Minnesota, have to a large extent turned over to their State Boards of Health the sanitary protection of their inland waters. In addition it is known that Delaware and California and, in Canada, Ontario and Quebec have vested in their health boards considerable authority to protect water supplies. In New York all plans for sewage disposal systems and in Massachusetts all plans for such systems or for water-works must be submitted to and approved by the State Board of Health. If a projected sewage disposal system promises to contaminate a stream used for a public water supply, the plans are not approved and the works cannot be built. In addition to this the laws of Massachusetts give its State Board of Health general supervision over all inland waters and prohibit the discharge of polluting matter in large quantities into streams used for public water supplies at points nearer than 20 miles above a water-works intake or into any body of water used as a water supply, and entirely prohibit the discharge of human excrement into such bodies of water. This prohibition has been in force since 1878. The Connecticut and Merrimac rivers, however, are exempted from this provision.

In 1885 the Legislature of Minnesota passed an act modeled upon the Massachusetts statute of 1878. The first clause of the act is as follows:

> No sewage, drainage or refuse or polluting matter of such kind as either by itself or in connection with other matter will corrupt or impair the quality of the water of any spring, well, pond, lake, stream or river for domestic use, or render it injurious to health, and no human or animal excrement shall be placed in or discharged into, or placed or deposited upon the ice of any pond, lake, stream or river used as a source of water supply by any town, village or city; nor shall any such sewage, drainage, refuse or polluting matter or excrement be placed upon the banks of any such pond, lake, stream or river within five miles above the point where such supply is taken, or into any feeders or the banks thereof of any such pond, lake, stream or river.

In case of violations of the above the State Board of Health of Minnesota, after a hearing, may:

> . . . order any person or corporation or municipal corporation to desist from the acts causing such pollutions, or to cleanse or purify the polluting substance in such a manner and to such a degree as shall be directed by said board before being cast or allowed to flow into the waters thereby polluted, or placed or deposited upon the ice or banks of any of the bodies of water, etc.

Aside from the New York act providing for the approval of sewage disposal plans there is one, passed in 1890, which authorizes the State Board of Health to make rules for the sanitary protection of the water supply of any city. Instead of providing, as does the Minnesota statute, that the parties causing the pollution shall stand the expense necessitated, there is a section in the New York act, as amended, the first part of which reads as follows:

> When the State Board of Health shall, for the protection of a water supply from contamination, make regulations the execution of which will require or will make necessary the construction of and maintaining of any system of sewerage, or a change thereof, in any or for any village or hamlet, whether the same be incorporated or otherwise, or the execution of which will require the providing of some public means of removal or purification of sewage, the municipality or corporation owning the water-works benefited thereby shall, at its own expense, construct and maintain such works or means for sewage disposal as shall be approved by the State Board of Health.

From the above it appears that the people of Massachusetts, New York and Minnesota have enacted specific laws to prevent the pollution of their water supplies, Minnesota excluding all sewage, Massachusetts setting a 20-mile limit and New York and Massachusetts compelling all plans for sewage disposal to be submitted to their State Boards of Health, which may disapprove them if not in accord with sanitary principles. Instead of prohibiting the pollution of water supplies by a general act, New York makes necessary separate regulations for each water supply and except for minor contaminations throws the burden of excluding or purifying sewage from existing plants upon the city benefited, a condition which has been established, it appears, by politicians, and not by sanitarians, and which, as applying to all cities which take advantage of the act seems unjust if not grossly barbarous.

Omitting further discussion regarding who should pay for excluding sewage from a water supply, the stand taken by three of our states that it must or may be excluded cannot be too highly commended, and until something arises to indicate the contrary, our State Boards of Health seem the proper bodies to be made the guardians of our water supplies, or such streams as may hereafter be needed as supplies.

Whether in the case of long streams, statute prohibiting the discharge of sewage into them are not too stringent, we will not undertake to dis- in the case of long streams the Minnesota statute is not too stringent we will not undertake to discuss at present, further than to say that in matters of health, as of engineering, it is always best to have an ample factor of safety. And it may be added that until our knowledge of the distance to which disease germs may be carried by running streams and of the length of their life in both running and still water is at a more advanced stage than now a large factor of safety is highly advisable.

The evidence is increasing from day to day that to impure water supplies are due a vast number of deaths from communicable diseases, and thus it behooves our legislators to enact laws which will place every possible safeguard about public water supplies, and, above all, to provide for intelligent supervision of them and for such experimental work as is needed to settle some of the unsolved problems relating to pure water. Meanwhile let every one do what he can to exclude sewage from our water supplies, and to preserve the natural purity of our inland waters wherever their use for receptacles for sewage would be prejudicial to the public health.

LETTERS TO THE EDITOR.

THE SILVER STATUS.

Sir: In your Aug. 10 number is an article on "The Silver Status," in which you make some errors, perhaps because you are not familiar with the facts. The production of silver has not reached any such alarming proportions as you imagine.

In 1853 the world's production of gold was about $150,000,000. It then was at the maximum. The production of silver last year was about 152,000,000 oz. It is probable that the maximum production of silver has been reached. You say that "there is every promise of indefinite further increase in the production of silver from known and seemingly inexhaustible sources of supply." Can you point out these inexhaustible sources of supply? Men who are familiar with silver mining do not find any known sources of supply inexhaustible. The best paying mines in Nevada were the mines on the Comstock vein. The bonanzas in those mines are exhausted and the mines are not now paying expenses. The greatest silver mine in Montana was the Granite Mountain. This mine no longer pays and is, I believe, closed down. The leading silver mine in Utah is the Ontario, which stopped paying dividends about a year ago. In Colorado the leading camp is Leadville. The mines that made Leadville so famous were the Little Pittsburgh and Chrysolite. These mines were exhausted years ago. The second camp is Aspen. It has been producing silver for eight years, and already the Emma, Vallejo and Spar, the three mines whose large bodies of rich ore gave the camp its first reputation, are no longer producing.

The Broken Hills mine in Australia for several years has been reckoned among the largest producers of silver in the world, but the amount of ore left in these mines that can be taken out at a profit is known to be very limited. With modern machinery silver mines can be exhausted much more rapidly than formerly, and nothing is more certain than that new mines must be discovered or the production of silver will soon begin to rapidly fall off.

In regard to the stability of silver permit me to say a word. There is but one law for determining the value of a commodity. The value of any commodity is what it will exchange for. Wheat is in value one of the most stable of commodities. Its stability is so well recognized that it is generally taken as the standard with which to measure the variations of gold. The gold price of wheat has fallen from $1.30 per bu. in 1873 to 55 cents, the price quoted in Chicago early this month. The silver value of wheat shows but little change. Compared with other commodities silver shows a similar stability and gold a want of stability.

Bank bills, checks and clearing-house certificates may serve as medium of exchange, but values are measured by standard money. In 1873 the standard money of the world was all the gold and silver that existed either as coin or as bullion available for coinage, and amounted to about $7,500,000,000. There has been a large increase in the population and business of the commercial world. To-day the standard money of the world is gold and amounts to about $3,750,000,000. The value of standard money depends upon supply and demand. Apply this law and you will see the reason of the great fall in prices. Was there any evidence that there was too much standard money in 1873? If not, how can you claim that there is enough now? If men had doubts about the unit of value would they not exchange those units for real property whose value would be permanent? As a matter of fact, is not every one exchanging all kinds of property at a sacrifice for those very units whose value you say is in doubt? Are you not a little in error in assuming that an appreciating standard is better than a depreciating one within the same limits, even for the creditor? If the standard depreciates steadily there is a loss in the purchasing power of the money, but there is a better demand for it and there is a greater certainty of debts being paid with rising prices. Men are failing every day who could easily pay all their debts if prices would remain stationary. You should count the effect of the shrinkage of values during the past year when you form your opinion of what would be the result of a permanent and continuous fall in prices. It is true men would be willing to lend if security were satisfactory, but who would dare to borrow? Who would dare to produce?

Respectfully, H. W. Reed.

Ouray, Colo., Aug. 17, 1893.

(We deem it but right to give the case put forward by our correspondent a hearing, especially as he well represents several other correspondents whose letters we cannot publish; but, as this journal is not devoted to financial or political topics, we must decline to allow its columns to be diverted to their discussion to any large extent. Our only excuse for entering upon it at all was that just at this time the subject is occupying the public attention almost to the exclusion of others, and that the practical interests of all our subscribers are deeply involved in the issue. No engineer can earn his living professionally except when some one is spending great sums on public or private works, either for construction or maintenance. Therefore, they are the first to suffer from financial stringency, and great numbers of them are now suffering severely, as we know.

Our correspondent's main argument is that there are no such inexhaustible sources of supply of silver as we spoke of, and he asks us to point them out. We should point out the State of Colorado as one place, so far as can be judged from present indications. It matters not that this mine or that gives out. The essential fact is that the yield as a whole keeps on increasing rapidly. In Mexico, however, there are a number of silver mining "camps" which have been producing silver on a large scale for nearly 400 years, and are still producing it, having been in and out of bonanza a dozen times in this period; for example, Zacatecas, Guanajuato, Pachuca, Chihuahua (the last more modern) and others. The Andes are also full of vast silver ore deposits which are not now worked for one reason or another, but are known to be of vast magnitude. The Comstock vein itself is far from exhausted. It is merely worked down to the point where expenses balance receipts under present conditions. Any decided mechanical advance, making it much cheaper to work the vein, would reopen it at once in full activity. The difference between silver and gold is that no known sources of gold supply exist from which under any circumstances any very large increase of supply can be obtained at whatever cost. It is idle to ignore this contrast. It is a leading factor in the present situation.

Mechanical advances of all kinds are being made continually. To that and not to appreciation of gold the great fall in price of almost all kinds of material commodities is to be ascribed. The conclusive proof of this fact is that the prices of all immaterial commodities, such as human labor, professional services and the like, have been steadily increasing, and were never so high as to-day. Nowhere is this fact better illustrated than in the state of Colorado, where heretofore unheard of gold wages have been paid to common laborers for producing silver, in spite of the admitted fact that the gold prices of all material commodities which they need to buy to live on average much lower than 20 years ago. As the total value of labor and service bought and sold yearly greatly exceeds the total value of all material commodities bought and sold, it is untrue and absurd to claim that the total sums transferred yearly for value received was ever done at higher mean prices in gold than it is to-day.

Our correspondent shows a tendency to go to extremes in his figures. The mean gold product of the world in the five years 1850-55 was some $132,000,000, not $150,000,000, and for the next five years about the same. It gradually fell to $100,000,000 in 1883-4, and has since recovered to nearly or quite its highest mean rate for 1850-60. On the other hand, the coinage value of the 152,000,000 oz. silver which our correspondent concedes for 1892 is some $186,000,000, which is just double what it was in 1877, and four times what it was in 1862, the increases ad interim being in quite uniform ratio. When is this increase to stop? How long will it take at the present rate of increase to flood the world with silver? Again, the price of wheat in 1873, which our correspondent gives as $1.30, is officially given as $1.15, and the next year it was only 94 cts. On the other hand, it is absurd to quote in comparison with such figures the price of wheat or stocks, or anything else "in Chicago early this month." Prices of everything have gone all to pieces temporarily, owing to causes in dispute. The mean price of wheat at the present time, taking several years together, may be fairly estimated at 70 to 75 cts., which is little, if any, lower than its average price for 30 years before 1860, when it frequently fell below 70 cts., as may be seen by referring to any extended table of prices. It is true that for some 12 or more years after our war the price of wheat ruled from $1 to $1.25, but special causes for that existed.

One thing our correspondent may accept as a certainty. Men will not loan "dollars," except at exorbitant interest, to be repaid later in other "dollars," which they fear may in the meantime have depriciated. It is logically warrantable to urge that no great harm would result ift hey refuse. That is a matter of opinion; but that they would in fact, refuse except on the hardest kind of terms, is a certainty.—Ed.)

NATURAL FILTRATION FOR WATER SUPPLY INTAKES.

Sir: I notice in your issue of June 15 an article on "Water-Works Intakes on Lake Michigan" which is very interesting and has some good suggestions. But as this is the age of improvements, let me suggest another remedy which I think still better and which is adapted not only for Lake Michigan, but for all other lakes and a good many rivers. All these bodies of water have from 8 to 20 ft. of sand on their shores, and these beds of sand and gravel extend out from 200 to 1,000 ft., sometimes farther. Now, instead of using some system to avoid the sand and gravel I would utilize it. Sand is the best and only natural filter we have. Take heavy wrought iron pipe and push it out horizontally in the sand under the water in the lake to a distance of 200 ft. or more, care being taken to keep the pipe 6 ft. or more from the surface of the sand. After the pipe is out the distance desired put in a strainer or screen made of solid brass (which will not corrode or stop up), with slots cut fine enough to exclude the fine sand; then withdraw the pipe for the length of the strainer and fasten it, leaving the strainer exposed in the sand 6 ft. or more below the surface. You can then attach your pump and draw water from the pipe with no fear of sewage contamination, as the sand is a purifier, and no fear of anchor ice stoppages nor of the shore ice piling up and breaking or stopping up the pipe. Such an inlet cannot be disturbed by wreckage of driftwood, and requires no extra machinery on shore for compressing air, or any other complicated appliances. It is merely putting a well in with a horizontal strainer in the sand below all danger points.

This plan was devised and has been used by the Cook Well Co., of St. Louis and Chicago, for several years, and has met with perfect success so far. You gave a description of their horizontal well system some time ago, but did not call attention to these very important features of it, which may be of value to your readers.

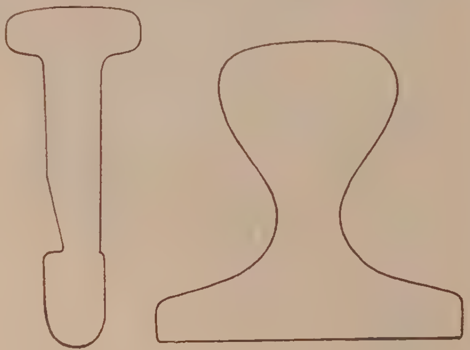
Respectfully yours,
L. D. May.

Lowell, July 23, 1893.

(The horizontal well system by which the water supply from Lake Michigan to the city of South Haven, Mich., is filtered was illustrated and described in our issue of May 11, 1893.—Ed.)

RAIL SECTIONS ON THE LONG ISLAND R. R. IN 1856.

Sir: On looking over my papers recently I found a tracing in pencil, made in 1856, from two of the rails used on the Long Island R. R. in Brooklyn, of which I send an approximately correct copy. The first form (from a siding) is one of the oldest used in this country, and the rail was supported on cast iron chairs; the other (from the main track) was spiked to the ties in the usual way, but of course without fishplates. By comparing these with the modern forms illustrated in your last number the difference will be found striking and instructive.



Rail Sections Used on the Long Island R. R. in 1856

Yours respectfully,
Brooklyn, N. Y. R. D. Dodge.

THE KNOWLES PUMP AT CLEVELAND.

Sir: A few days ago I read an article in your paper about the breakdown of a Knowles pump at the Cleveland water-works. After reading this article I addressed a letter to the Blake agents in Cleveland, Messrs. Lord, Bowler & Co., and asked them to investigate as to the magnitude of the breakdown. They sent the letter, which I inclose, and which I wish you would read, so that you may see the insignificance of the break, and the importance of publishing it to the reading public.

I beg to call your attention to the fact that these two 15,000,000-gallon pumping engines manufactured by the Knowles Steam Pump Works have been in constant use in the Cleveland water-works for the past six years, performing more work than any of the other pumping engines in the city water-works, and they have never cost anything for repairs.

Yours truly, Lewis S. Silva.
New York, Aug. 9, 1893.

The letter inclosed from Messrs. Lord, Bowler & Co. reads in substance as follows:

> The breakdown to the Knowles pump was caused by one of the clamp nuts on the valve stem inside the steam chest, working off or dropping off. It fell in such a way that the valve caught it in making a stroke, and jammed it against the end of steam chest, preventing the valve going as far as its travel. Something had to give way, and the crank arm broke, of course stopping the pump. The repairs were made at the Globe Iron Works very easily, and the pump is working again as good as ever.
>
> A similar accident has happened three times to the Worthington engines, twice to one, and once to the other, but fortunately when the joint nut or clamp nut fell off its rod it fell on the side of the valve and not on the end, so there was no breakage, although the engine was stopped until that nut or a new one was replaced.

THE MANUFACTURE AND USE OF PAVING BRICK.*

By Daniel W. Mead, Assoc. M. Am. Soc. C.E.

The generic term brick includes within its meaning classes of material of such wide variations in their partcular qualities as to need a more definite classification when considering the adaptability of such classes to particular purposes. So, when we consider a certain class of this material for street paving it must not be confused with other classes manufactured for other purposes and perhaps entirely unfit for this particular use. These manifold qualities of brick are due partially to methods of manufacture, but more largely to greatly diversified qualities of the clay from which the brick are made.

Occurrence and Distribution of Clays.—Clays may be classed as to their origin and occurrence as follows: (1) Residuary clays result from the disintegration of rocks in place. The soluble and binding materials are leached out and washed away and leave the insoluble materials in a more or less divided form, as clay. This takes its character from the character of the rock from which it is derived, modified by the action of water. Some of the purest clays are derived in this way from feldspathic rocks from which the alkalies have been leached, leaving a clay closely resembling kaolin (pure clay). Other less pure clays are derived from the disintegration of limestone, sandstone, etc.; in each case, however, the soluble constituents are almost entirely gone, leaving the insoluble silicates, quartz grains, alumina and ferric oxide. Clays Nos. 1, 2 and 3 in Table I are examples of this class of clays. (2) Drift clays are the result of the mechanical action of the ice during the glacial period, by which the various formations were ground up and mechanically transported and redeposited largely without the aid of water. These clays represent the character of the mother rock much more accurately than those of class 1, as in this case the soluble matter is largely retained and not leached out, except by the action of the water, since their deposition. (3) Alluvial clays are residuary and drift clays rewrought and redeposited by fluvial agencies. (4) Indurated clays, or argilacious rocks and shales, are formations resulting from the disintegration of the earlier rocks by various influences and their re-formation into new strata. They have usually been subjected to great pressure from the superincumbent rocks, to which pressure they owe their physical character to a large extent.

Of these four classes, the residuary clays (class 1) are found wherever rocks and the result of their disintegration have been undisturbed by fluvial or drift influences, and are hence found largely outside the drift areas. The clays of class 2 are found within the drift sheet and constitute the common brick clays of the Northern States. Those of class 3 occur along the various river courses; while those of class 4 occur in the many geological horizons, which we may briefly summarize as follows, beginning with the oldest and lowest geological horizon: (a) In Utica slate as a dark carbonaceous clay slate, hard in Pennsylvania, soft in New York, sometimes interbedded with impure limestone. (b) In the Hudson River shale as shales and slates more or less interbedded with limetone (over 5,000 ft. thick in Pennsylvania and 200 ft. thick in Illinois). (c) In the Salina (or Onondaga salt group) as a red shale (in New York State, from 1 to 500 ft. thick). (d) In the Devonian as the Marcellus shales, a black slate, somewhat bituminous. As the Hamilton group, consisting of slates, shales and sandstones, 300 to 700 ft. thick; as the Genesee formation, the black slate of the west and south; as the Portage group, consisting of shales and flagstones; as the Chemung group, consisting of thin bedded shales, sandstones and flagstone. (e) In the Carboniferous, in which are developed the most extensive beds of fireclays, potters' clays, shales, soapstone, etc., interbedded with sandstone, limestone and coal. (f) In the Triassic, which usually consists of dark sandstones, oft shales and coarse conglomerate. (g) In the Cretaceous and Tertiary, which consists of earthy formations of sand and clays.

Of the deposits of clay above named, the clays from the carboniferous period are most widely utilized for the manufacture of paving brick. At Columbus, O., the Devonian shales, or the product of their disintegration, is utilized, while at Syracuse the Salina shale is found available. Some few drift clays are also successfully used for the manufacture of a fair quality of paving brick, notably at Decatur, Jacksonville and Urbana, in Illinois. A mixture of drift clay and carboniferous clay is utilized at Brazil, Ind., for the manufacture of paving brick. The accompanying map shows the distribution of the carboniferous deposits east of the Rocky Mountains and also the outline of the drift area. It also shows the location of the principal paving brick factories and the principal cities which are now using this material for paving within the terrtory shown.

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*Abstract from a paper read before the International Engineering Congress at the World's Columbian Exposition.

Character of Clay.—As may be judged from its wide occurrence and manifold compositions, clay varies widely in its extreme characters; but all materials to be classed as clays must have certain constituents in common. The essential ingredient is a hydrous silicate of alumina, known as kaolin, which, according to Prof. G. H. Cook, is composed of:

Silica....	46.3
Alumina....	39.8
Water......	13.9
	100.00

This may be considered a pure clay, and is rarely, if ever, found in nature. To this is commonly added in varying quantities, silica, lime, magnesia, ferric oxide, potash and soda. The presence of these substances, which may be regarded as the impurities of clay, and the physical condition under which they exist, cause the wide variation in the clays themselves and to a great extent in the manufactured product made therefrom.

Character Due to Chemical Constitution.—Pure alumina will resist the highest temperature of the blast furnace, in which crystalline quartz (silica) will be only slightly affected, both being practically infusible. Alumina shrinks, warps and cracks greatly in drying, but gives plasticity and adhesiveness to the clay and strength to the product. Silica prevents cracking and distorting, the more silica being present the less the shrinkage. But the more silica the less plasticity and adhesiveness of the clay and the less strength and greater brittleness. Lime and magnesia, while infusible in themselves or with alumina, fuse in the presence of an excess of silica, as do also several other common ingredients of clay, and form a "vitrified brick."

It is found that potash has the most active fluxing effect on clay, after which follow soda, lime, magnesia and iron, in the order named. To "vitrify," a clay should contain at least 3% potash, or 3½% of soda, or 5% of lime or magnesia, or 8% iron, or a combined proportion of any or all of these fluxes equal to these amounts. An appreciable less amount of these fluxing elements will leave the product more of the nature of a firebrick, unvitrified and porous, and, as a rule, unfit for paving purposes. A greater proportion than above specified is desirable, and will make the clay more easily vitrified at a less heat, and is to some extent a measure of its economic manufacture, as a lower heat and consequently less fuel will be required in its burning. Too great an amount of these fluxes, amounting, perhaps, to three times the quantities above mentioned, will render the clay hard to handle on account of great fusibility. According to Richter, lime and magnesia are more active fluxing agents than potash and soda, but his conclusions do not agree with American experience. The presence of lime or magnesia in a paving brick in reasonable quantities is not believed by the writer to be detrimental to the brick if it exists in a finely divided state and is intimately commingled with the other constituents, so that a silicate of lime or magnesia will be formed in the burning. The Milwaukee building brick is one of the best of common brick, and it contains a large percentage of lime, and Portland cement contains often as high as 60% of lime. In each case, however, the lime exists in close chemical or physical union with the other elements of the material.

Iron in considerable quantities has a fluxing effect with silica and to this extent cements it together and gives it strength. It is not the most valuable of constituents in this regard, however, and its presence is not essential to a first-class paving brick. Iron, when present, is usually in the form of hydrous peroxide or protoxide of a yellowish or bluish color. During the burning, the water of crystallization is expelled and the iron takes the form of the red peroxide, giving its color to the material in proportion to the amount present. Potash and soda fuse at a lower temperature than the other constituents of clay, and their presence in suitable quantities is desirable for the manufacture of vitrified paving brick.

In Table I. the analyses of various paving-brick clays are given with that of some other noted clays for comparison. These analyses have been compiled from a variety of sources too numerous to be mentioned in detail.

Character Due to Physical Condition.—The influence of physical condition is equally important to that of chemical character. Many of the clays from the older formations have been compressed and consolidated and form slates and other hard argillaceous rocks; others less compact form the shales, while others exist in a plastic form. There is a marked difference in their adaptability for manufacturing use under these varying conditions, and the methods of manufacture must be largely determined by them. If a clay is not found naturally in a plastic condition, it must be reduced to a finely divided state by mechanical means before it can be tempered and made into paving brick. While as previously noted, the fusing of clay depends on its constituents to a great extent, yet its physical condition also modifies this quality largely. Coarse clay, even with considerable of the fluxing materials, will resist considerable heat. The more finely clay is ground the more easily it is vitrified and the tougher, stronger and more impervious its produce becomes. Fineness in grain is an essential feature of the best paving clays.

The ingredients of the clay exist in various forms which affect the clay and its product. The uncombined silica may be more or less finely divided and its condition has its effects on the action of the fluxes. In clays derived from feldspathic or micaceous rocks, undecomposed feldspars and micas sometimes occur. Lime, instead of being finely divided, may occur as lumps or pebbles. in which condition it will unite with the other ingredients only on its surface, the balance burning into caustic lime, which, on exposure, will gather moisture and slack, disintegrating and crumbling the brick. In general, a clay which will not readily melt and run, and yet one which will fuse and vitrify, but keep its shape, is essential to the manufacture of the best paving brick. Analysis and physical examination will point out the probability of the development of certain characteristics in the manufactured product, but, after all is done, the only thorough test is the working of the clay by suitable methods and its proper burning.

TABLE I.—Showing Analyses of Paving-Brick Clay from Various Localities.

	Silica.	Alumina.	Perox. of iron.	Protox. of iron.	Lime.	Magnesia.	Potash.	Soda.	Water and loss.	Undetermined.	Total.	Geological source of clay.
Kaolin	46.30	39.80	....	....	....	....	....	....	13.90	....	100.00	Pure clay.
Stonebridge, Eng...	67.34	23.03	....	2.03	....	....	1.38	1.38	8.24	....	102 02	Fire clay.
Mt. Savage, Md., non plastic. . .	50.46	35.90	....	1.50	0.13	0.02	*Nil*	*Nil*	12.74	Mang. oxide, trace.	100.75	" "
Milwaukee (white brick)...........	38.22	9.75	2.84	1.16	3.24	15.83	2.16	0.65	2.80	Carb. of lime, 23.20	99.85	Drift clay.
Philipsburg, N. J...	56.78	17.38	6.50	Phosphorus, 0.133	4.14	3.15	and organic matter, 3.427	and carbonic acid, 7,600		Sulphur, 0.89	99.910	
Syracuse, N. Y.....	67.67	11.67	6.53	....	12.74	0 95	0.80	0.80	....	......	100.36	Salina shale.
Cumberland, W. Va	69.02	22.07	4.53	....	1.70	0.38	1 34	1.34	....	0.96	100.00	Carboniferous.
New Brighton, Pa..	67.36	22.05	5.61	....	0 86	0.36	2.70	2.70	....	1.06	100.00	"
Canton, O...........	67.65	18.36	8.34	....	0.80	1.02	2.58	2.58	....	1.25	100.00	"
New Lisbon, O......	64.08	25 32	5.44	....	0.30	0.29	0 63	0.63	....	3.94	10 .00	"
Middleport, O......	71.57	17.06	8.34	....	0.50	0.58	0.56	0.56	....	1.39	100.00	"
Brazil, Ind..........	77.67	14.77	3.63	....	0.38	0.27	2.43	2.43	....	0.85	100 00	" and drift.
Columbus, O........	66.30	18.62	9.78	....	0.40	0.84	1.89	1.89	....	2.17	100.00	Devonian shale.
Akron, O.............	60.05	20.00	6.82	....	0.52	0.45	1.79	1.60	1.95	Sulphur, 1.95	101.11	Carboniferous.
Haydensville, O....	72.24	16.87	Iron 0.16	....	0.50	trace	1.09	1.09	5.14	....	100.00	"
Zanesville, O	61.80	20.76	8.70	....	1.38	1.09	1.44	1.44	... .	4 83	100.00	"
Robbins, Tenn......	70.57	15.19	7.97	....	0.78	0.32	1.15	1.15	....	4.02	100.00	
Rock Island, Ill....	60.64	22.84	6.10	... .	0.24	0.75	3.28	0,57	5.00	....	99 42	Carboniferous.
Galesburg, Ill......	68.69	17.95	7.25	....	0.76	1.47	2.83	2.83	....	1 05	100.00	"
Ottawa, Ill..........	52.26	33.47	....	4.51	3.01	2.91	1.10	1.10	2.74	....	100.00	"
Clinton, Ia.	75.50	13.04	Iron 4.00	....	0.50	....	4.50	....	3.00	....	100.90	Hudson River shale.
Burlington, Ia......	77.40	11.74	3.29	....	1.60	1.91	3.76	0.47	....	... .	100.17	Carboniferous.
Bloomington, Ill....	67.80	11.55	4.31	....	8.90	5 32	2.62	2.62	.... ..	....	100.00	Drift clay.
Ft. Smith, Ark.	57.10	23.74	8.18	.. ....	0.53	1.04	1.53	0.87	7.31	....	......	Carboniferous
Kansas City, Mo...	64.37	19.73	9.07	....	0.82	2.32	1.89	1.89	... .	1.80	100.00	"
Leavenworth, Kan.	58 45	21.96	Iron 8.43	....	1.05	1.57	2.00	2.00	6.51	....	99 94	"

The Manufacture of Brick.—The greatest diversity, both in the mechanical and chemical constitution of clays, renders the question of method of manufacture a difficult one, for the knowledge of the successful utilization of one clay is not wholly applicable to another. All clays are improved by being loosely thrown up and exposed to the weather, and some clays are improved by thoroughly wetting and allowing them to lie for a day or more. The nearer homogeneous and fine grained a clay naturally occurs, the fewer processes necessary in handling it.

The soft mud process is used only to a very limited extent in the manufacture of paving brick, Bloomington, Ill., being the only place familiar to the writer where this process is still used. The dry press process of brick manufacture has not as yet come widely into use for the manufacture of paving brick, although certain clays might be worked by this method. and the writer understands that some paving brick are being made at Middleport, O., and Louisville, Ky., by this method, although he has not seen them. What is known as the stiff mud process is the one usually adopted for the manufacture of paving brick and seems to be the best adapted for the present circumstances of its manufacture.

The clay, if indurated, is first reduced to a powder, usually by means of the granulator or dry pan, and then thoroughly tempered in a suitable pug mill before passing to the brick machine. As a rule, the longer and more thoroughly the clay is worked or tempered, the more uniform and better will be the resulting product. The auger machine has given the best satisfaction in the manufacture of stiff mud brick, and the machine makers of the United States have adopted this type of machine almost universally. On leaving the machine, the brick manufactured by this process are dry enough to handle; and they are placed on trucks or cars and conveyed at once to the dryhouse. Some makers re-press their brick before drying, but it is not common practice at present, although many factories furnish both common and re-pressed paving brick.

Drying.—Several systems of drying are in successful use among the paving brick manufacturers: (1) By a hot floor, which may be produced by furnaces or steam pipes under the floor over which the brick are hacked to dry. (2) By slatted floors under which are steam piping and over which the brick are hacked to dry. Sometimes a modification of this method is used in which the dryhouse has racks from floor to ceiling on which the brick are placed for drying. (3) A system of flues or tunnels into which the brick are run on cars, which will hold about 500 brick each. These tunnels are heated by means of furnaces or steam pipes. The third method in one of its various forms seems best adapted for handling large quantities of brick, as the brick can usually be dried in from 18 to 36 hours by this method, where it takes from one to five days on the dry floor and from five to ten days if dried in racks. The saving in time and cost of handling is also considerable. Outdoor drying is a method too slow and uncertain for practical use in handling large quantities of brick. Clays vary greatly in the facilities with which they may be dried. Clays highly aluminous must be dried with great care and often very slowly, otherwise they warp and crack, while those with much silica will stand forced drying. Thorough drying greatly facilities the burning of the brick.

Burning.—There are two methods used for burning brick. The ordinary way in which common building brick are burned is in the updraft or clamp kiln. This furnishes good ordinary brick, but it is almost impossible to get a uniform product, not over 40% of the brick in a kiln being available for "pavers." The down draft kiln secures a uniform and much higher temperature, a large percentage of the brick, from 80 to 90% in a well designed and well constructed kiln, being suitable for paving purposes.

In burning brick, the fires must be started slowly in order to "water smoke" the brick without cracking them. In the brick, as they come from the machine, there is from 20 to 30% of water; about 50% of this water is the water of the pores, and is removed at a temperature of 212° F. in the drying. The balance is lost at a temperature of about 1,400° F. in the burning. The loss of the physical and chemical water of the brick is accompanied by a corresponding loss in weight, and a considerable shrinkage in the dimensions of the brick, as may be seen from the following table:

	On leaving machine.	On leaving dryer.	Burned not vitrified.	Vitrified.
Weight......	6.46 lbs.	5.79 lbs.	5.08 lbs.	5.08 lbs.
Length	8⅙ ins.	8 ins.	7⅞ ins.	7¾ ins.
Breadth......	4$\frac{7}{16}$ ins.	4$\frac{3}{16}$ ins.	3⅞ ins.	3¾ ins.
Thickness ..	2½ ins.	2¼ ins.	2⅛ ins.	2 ins.

Average of 12 samples.

Slow firing is continued until the smoke passing off shows no further signs of the water smoke (steam), after which the fires are gradually raised until the temperature throughout the kiln is sufficient to vitrify the brick, at which point it is held until they reach the proper point of vitrification, which is shown by the trial pieces or whole brick taken out through inspection holes in the top and sides of the kiln. After this, the kiln is gradually cooled down and the brick removed. Too rapid cooling is detrimental, as the brick are rendered very brittle. By slow cooling the brick are annealed and rendered tough. The burning occupies from two to four days for water smoking, from four to six days for burning proper, and from three to five days for cooling.

Table II. gives some details of the methods of manufacture as used at different paving brick factories in the United States.

Qualities of Paving Brick.—In all lines of practical work experience with a given material is the only satisfactory method of determining the value of its various qualities. As in the case of cement, stone and wood, paving brick must be selected with due reference to the uses to which they are to be put; that is to say, to the nature and extent of the traffic they are to encounter and the character of the climate they are to withstand. A large percentage of clays are undoubtedly capable of producing brick suitable for country roads, light suburban travel and residence streets of towns and cities. From many can be made brick which will withstand the moderate traffic of the smaller cities of from 30,000 to 50,000 inhabitants. It is the writer's belief that clays can be found which, if properly manufactured and properly placed in the pavement, will outrival granite under the heaviest traffic, and some brick are now made which it is believed would prove economical under such traffic.

The color in a brick is no criterion of its value as a paving brick when comparing brick of various makes; but, in inspecting brick from a single factory, the color will usually furnish a fairly safe guide as to the relative hardness, when the inspector is thoroughly acquainted with the particular manufacture. Another criterion as to the character of any single make of brick is the comparative size. As the harder a brick is burned the smaller it becomes up to a certain limit, which must be determined for each make of brick, the unduly large brick may be unhesitatingly rejected as too soft. In general, a brick for paving purposes must be homogeneous, free from uncrushed or lumpy material, especially if such material is not united by vitrifaction with the balance of the material of the brick. Vitrifaction is desirable, but not essential, as many paving brick, especially those made in West Virginia, cannot be classed under this head. These are made from clays very near fireclays in character and are giving very good satisfaction, at least under moderate traffic.

In this country the climate in which the majority of paving brick is used is so severe that the disintegrating effects of frost are the most severe test a paving brick must stand, especially in streets of moderate traffic. Hence, one of the first requisites of such a brick must be that it will not absorb a large percentage of water. The permissible ratio of absorption cannot be definitely fixed at any given percentage, for it is found that this ratio varies with different classes of brick. One class of brick, which seems to be uniformly made from clays which approach near to fireclays in character, will admit 4% or 5% of water and still not crumble through the action of frost; while others, if not burned hard enough to render them impervious to more than 2½ to 3%, will be rapidly disintegrated by the frost. A core or lamination affords a seam where the frost may enter and is inadmissible in paving brick. Fire cracks should be limited in number and extent. The presence of lime, in itself, is not detrimental in limited quantities, yet this must not exist as lime pebbles or it will render the product entirely unfit for use by disintegrating and crumbling it.

TABLE II.—Showing Methods of Manufacturing Paving Bricks Now in Practice.

Locality.	Kind of Clay.	Geological Origin.	Methods of Manufacture.	Method of Drying.	Character of Kilns.
Brazil, Ind	Fire clay and surface clay mixed.	Carbonif. and drift	Dry pan. Pug mill. Stiff mud machine.	On slat floor.	Down draft.
Decatur, Ill	Surface clay.	Drift.	Roller crusher. Stiff mud machine.	On rack in steam-heated dry house.	Down draft.
Bloomington, Ill.	Surface clay.	Drift.	Vertical pug mill. Soft mud machine.	In yard.	Up draft.
Galesburg, Ill...	Shale clay.	Carbonif.	Dry pan. Pug mill. Stiff mud machine.	On cars in drying tunnels.	Square down draft.
alesburg, Ill....	Shale clay.	Carbonif.	Dry pan. Pug mill. Stiff mud machine.	On hot floor heated by furnaces below.	Round and square down draft.
Evansvlle, Ind....	Shale clay.	Carbonif.	Dry pan. Mixer. Pug mill. Stiff mud machine.	Tunnel dryer.	Square down draft.
Rock Island "	Shale clay.	Carbonif.	Dry pan. Screen. Pug mill. Stiff mud machine.	Tunnel dryer.	Round down draft.

The specific gravity of a brick is somewhat of an index of its comparative value, as the more material contained in it, the greater its density, and other things being equal, the greater its resistance to abrasion, crushing, etc. A certain amount of toughness is desirable in a paving brick, to prevent splintering and breaking under traffic. This quality, the writer believes, is at present overestimated, as when laid in the street a brick can splinter only to a limited extent at the corners after which the shape assumed is such as to greatly resist abrasion. The brick must be of sufficient transverse and crushing strength to resist all the demands of traffic with a sufficient factor of safety. Further than this these qualities are of little material value.

Testing the Material.—In making tests for relative qualities of brick nothing will take the place of experience. A few general suggestions, however, for making ready tests, such as are now in use, are offered with the hope that they may prove serviceable. The test for crushing strength is believed by the writer to be of little or no value unless in comparison of the values of high-grade paving brick. The test is difficult of application, requiring expensive machinery; and unless carefully made by skilled observers, under definite given conditions, the results are very uncertain and unreliable. The transverse strength can be determined with greater accuracy than the crushing strength; it also represents both the compressive and tensile strength of the material, and is, therefore, a better test of the qualities of the brick. In testing for ratio of absorption the brick should be placed in a drying oven and kept at a temperature of about 212° F. for 10 hours or more if they have previously been saturated. They should then be weighed, and after the weight is carefully determined, placed in a vessel of water and kept for 24 hours at a temperature of about 60° F., after which they should be taken out, the surface water carefully removed and again carefully weighed. The gain in weight, divided by the original weight, will give the ratio of absorption. The presence of caustic lime is easily told by immersing the brick from one to four days in water. If caustic lime be present it will make its appearance by breaking or cracking the brick or by "poppers" showing on the surface. The specific gravity can be readily determined. The test for toughness or abrasive strength is usually made in an ordinary foundry tumbler. The brick should be tested a few at a time, with about 100 lbs. of "foundry shot," weighing not more than ¼ lb. to the piece. Heavy pieces of iron should not be used in this test, as they break the brick to pieces instead of wearing it. The different shapes of brick are apt to make a material difference in their wear during the first half hour. This is caused by some brick being manufactured with rounded edges, and some with square edges; the latter, being more easily broken or abraded, cause a greater loss in the material so made. For this reason they should be weighed after the first half hour, and the results of the second or third half hour used for comparison.

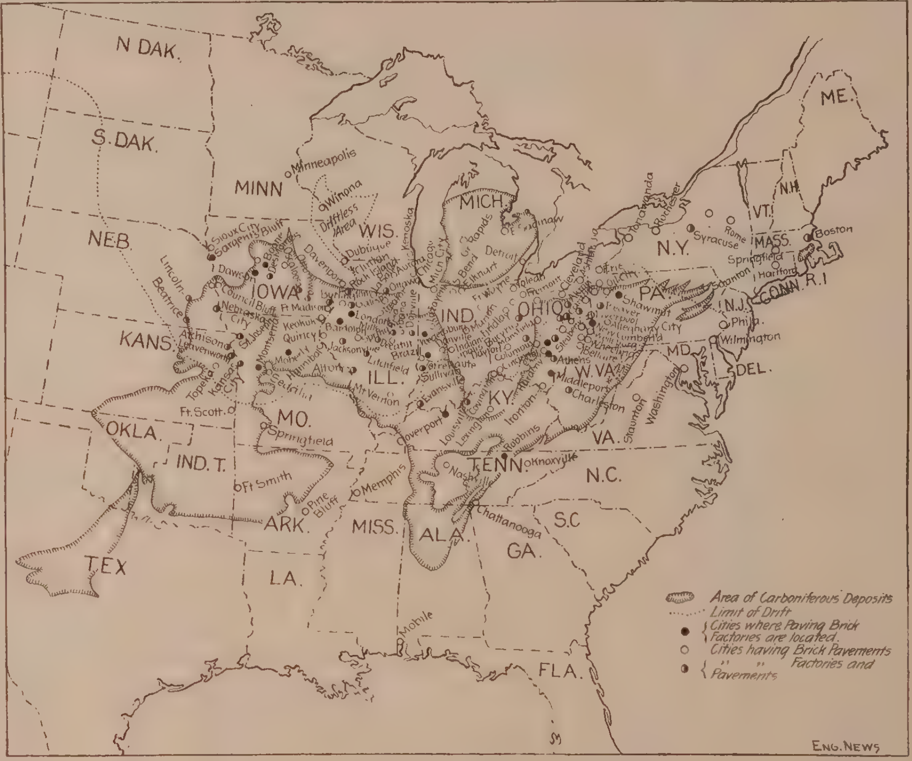
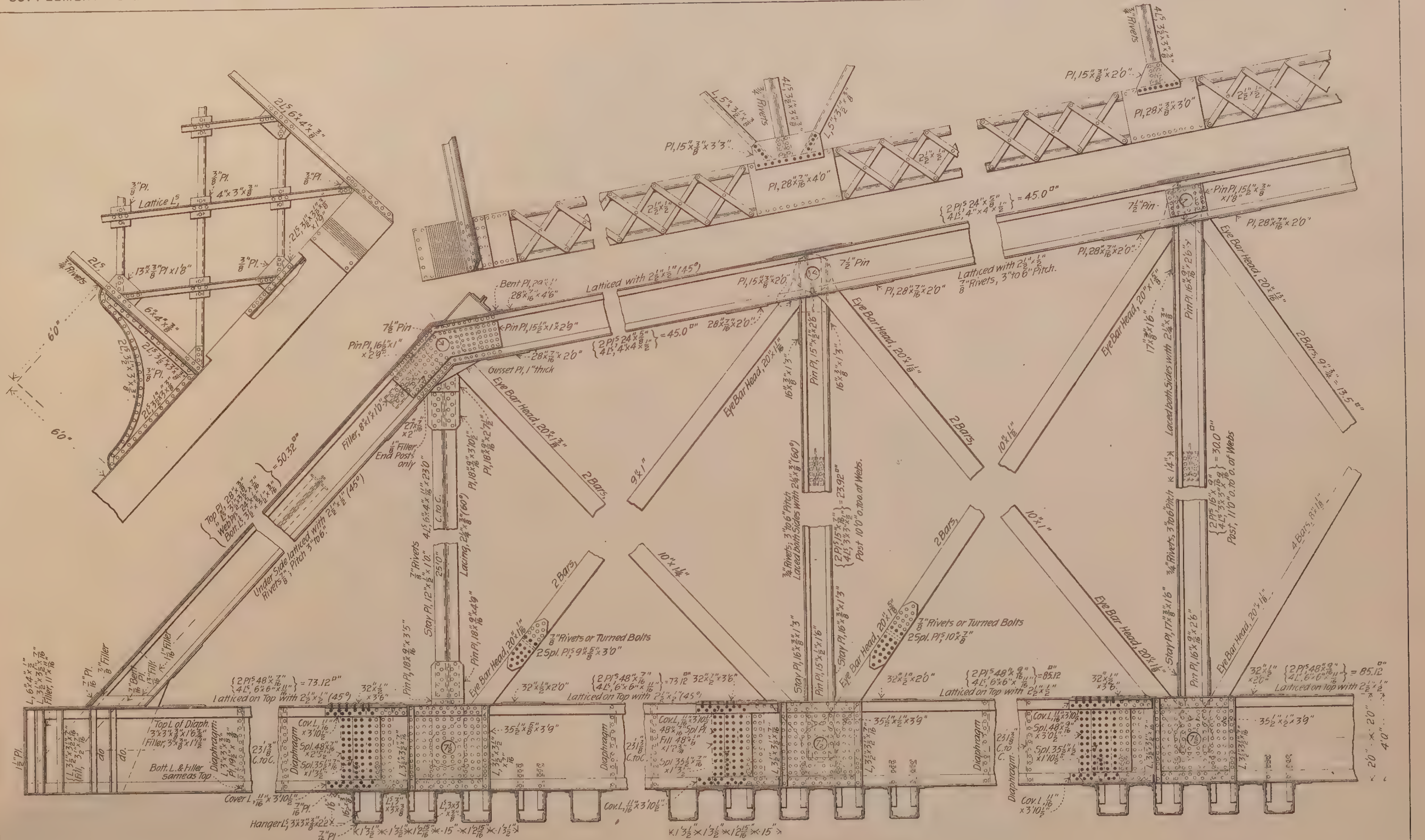


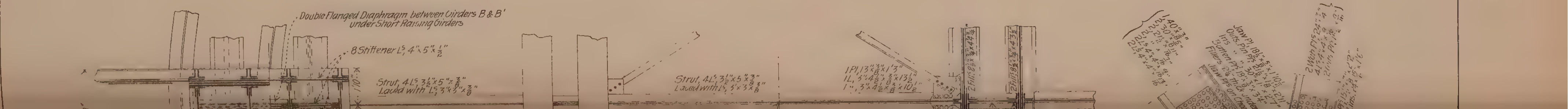
FIG. 1. MAP SHOWING LOCATION OF PAVING BRICK CLAY DEPOSITS AND CITIES MANUFACTURING AND USING BRICK PAVING.

Specifications.—The large majority of specifications for paving brick are entirely inadequate. They are vague and often meaningless. It should be remembered that each additional requirement cuts out certain classes of brick, lessens the competition, and in that way, and by reason of the extra cost in the manufacture of a higher grade article, increases the price of the finished pavement. It must also be observed that with the present demand for paving brick and the state of the manufacture in many places where factories have been recently established, it will often be impossible to obtain brick which will fall within the higher limit herein named. Hence, the engineer should assure himself of the best quality of brick which can be obtained in sufficient quantities for his use, before adopting specifications calling for any particular grades of paving brick.

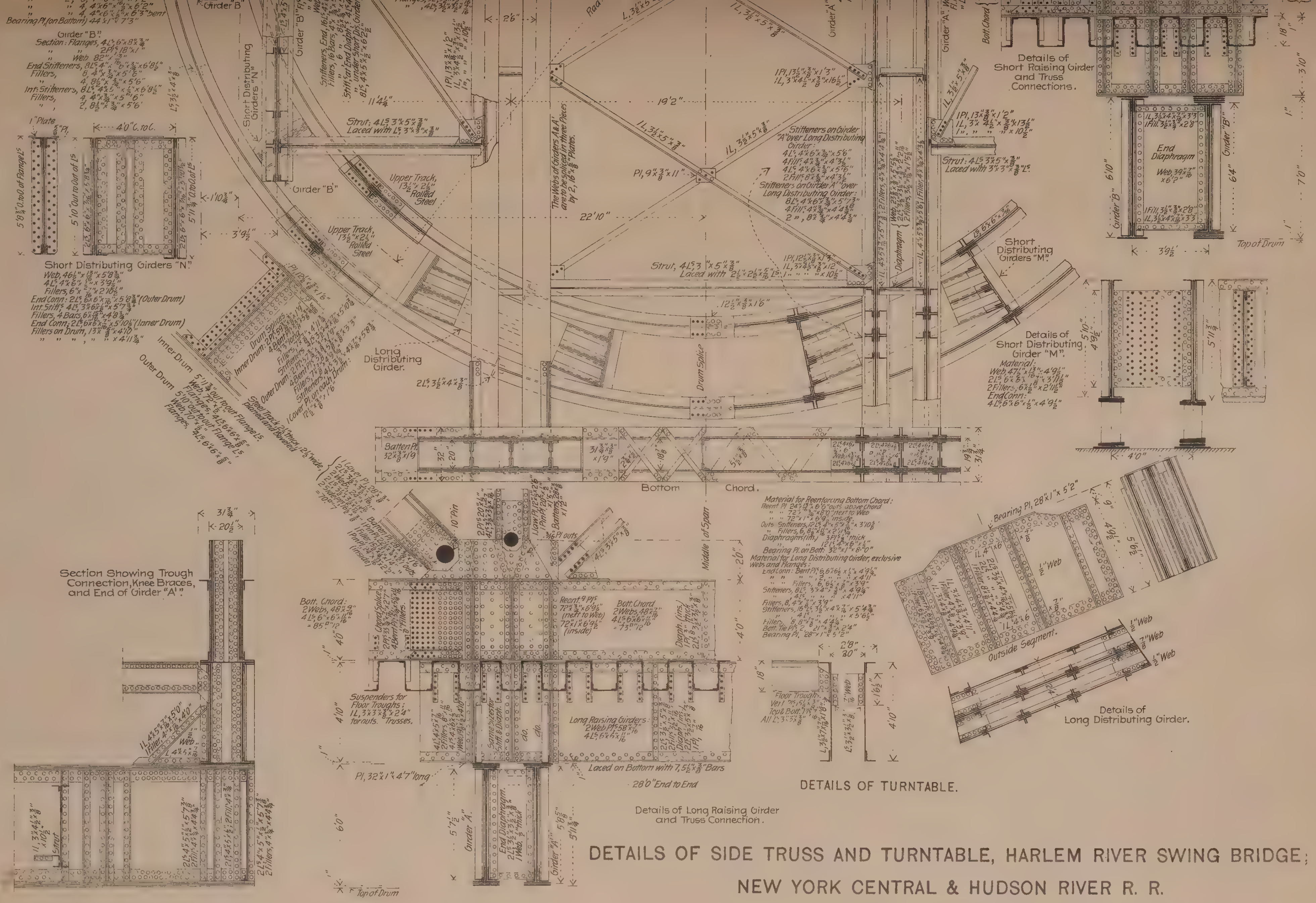
The Pavement.—The use of brick for paving in the United States has been confined to the last two decades. Its first use was at Charlestown, W. Va., and at Bloomington, Ill., about 20 years ago. From these points, with their small beginnings, its use has spread until at present it is one of the most popular and widely used of all paving material. A discussion of the principles that underlie brick paving would be a discussion of the principles of all paving. This material simply offers a surface covering, smooth and even, but not slippery, durable, economical and highly sanitary. It must be laid on a foundation drained and prepared as for all pavements. Beyond this the success of the pavement depends on the proper selection of the material. With poor material it will prove a failure, as has been shown by the attempt to utilize common building brick at Nashville, Tenn., and elsewhere. With proper material it is an established success, and is destined, with the improvement in manufacture and the better-



DETAILS OF SIDE TRUSS.



Double Flanged Diaphragm between Girders B & B' under Short Raising Girders
8 Stiffener L^s, 4"×5"×1/2"
Strut, 4 L^s, 3½"×5"×3/8"
Laced with L^s, 3"×3"×3/8"
Strut, 4 L^s, 3½"×5"×3/8"
Laced with L^s, 3"×3"×3/8"
10"


Details of Short Raising Girder and Truss Connections.
End Diaphragm
Girder "B"
Top of Drum
Short Distributing Girders "N".
Short Distributing Girders "M".
Details of Short Distributing Girder "M".
Upper Track, 13½"×2¼" Rolled Steel
Long Distributing Girder.
Inner Drum
Outer Drum
Drum Splice
Bottom Chord.
Middle of Span
The Webs of Girders A & A' are to be spliced in three Pieces by 2, 18"×⅝" Plates.
Strut, 4L^s 3"×5"×⅜" Laced with 2½"×2½"×⅜" L^s
Stiffeners on Girder "A" over Long Distributing Girder
Material for Reenforcing Bottom Chord
Material for Long Distributing Girder, exclusive Webs and Flanges
Bearing Pl, 28"×1"×5'2"
Outside Segment.
Details of Long Distributing Girder.
Section Showing Trough Connection, Knee Braces, and End of Girder "A".
Long Raising Girders
Suspenders for Floor Troughs
Laced on Bottom with 7,5½"×⅜" Bars
28'0" End to End
Girder "A"
End Diaphragm
Details of Long Raising Girder and Truss Connection.
DETAILS OF TURNTABLE.
19'2"
22'10"
10" Pin

DETAILS OF SIDE TRUSS AND TURNTABLE, HARLEM RIVER SWING BRIDGE;

NEW YORK CENTRAL & HUDSON RIVER R. R.

Walter Katté, Chief Engineer. Geo. H. Thomson, Bridge Engineer.

CHAS. HART & SONS, LITH., 36 VESEY ST., N. Y.

ing and cheapening of the product thereby, to rank first in economy and availability of all paving material. In the majority of places it offers a possible local industry, when the availability of the local geological resources are better known and appreciated, and the different methods of utilizing them in manufacturing are more thoroughly understood.

In first cost the pavement depends on the nearness of the manufactories and the local resources suitable for foundations. For light traffic the fragmentary materials (rubble, gravel, sand, etc.), or sand with a layer of brick laid on their side, or 6 ins. of concrete, make good foundations, the selection depending on the local resources. For medium traffic, 9 ins. of stone or gravel, or 6 ins. of gravel or stone, with a layer of brick laid on their sides, bedded in sand, or 6 ins. of concrete, will give good results. For heavy traffic the stone or gravel should be at least one foot in thickness, or the concrete at least 9 ins.. All sub-foundations which are retentive of water should be properly and thoroughly drained.

In the average city the network of pipes and conduits laid below the street surface is the cause of frequent disturbances of the pavement which is often the leading factor in its destruction. The facility with which pavements can be taken up and replaced becomes, under such circumstances, quit important. In this brick pavement is second to none. The brick, being uniform in size and shape, can be returned to their places by unskilled labor, an important point in smaller towns and cities. This is especially true if the fragmentary foundations are used, and if sand only is used in the joints. Where either coal tar or cement grout is used in the joints, the brick taken up are difficult and often impossible to clean, and new material has to be substituted. With sand in the joints the old material is readily cleaned, and the sand, in two weeks' time after laying, renders the pavement as impervious to the seepage of surface waters as the tar or cement.

The durability of brick pavements is a subject open to inquiry, for the limited time they have been in extensive use has been too short to answer this from practical experience. The destruction of a pavement results from (1) the crushing by the wheel load; (2) the abrasion by friction of passing vehicles and the slipping of horses' shoes; (3) the impact due to the passage of loads over a rough surface, and the impact from the shoes of horses. The smoothness of brick will, in the opinion of the writer, more than overcome the difference in abrasive resistance of the granite. The writer estimates the life of first-class brick pavements to be: For light traffic, 35 to 50 years; for medium traffic, 20 to 25 years; for heavy traffic, 10 to 15 years. The smoothness of brick renders it free from much of the objectionable noise of the rougher pavements. Its freedom from decay, and its non-absorption of water are sanitary qualities of considerable value. It produces little dust of its own and as it is not retentive of mud and dust, it can be readily cleaned. Being smooth without being slippery, it offers comparatively little resistance to traction, while affording a fair foothold for horses.

TABLE III.—Showing Character of Brick Pavement in 42 Cities of the United States.

City.	Years in use.	Foundation.	Depth of sand cushion, ins.	Size of brick, ins.	Filling of joints.	Average cost per sq. yd.
		Eastern and Southern States.				
Hartford, Conn.	½	Sand	....	3 × 4 × 9	Tar	$2.75
Wilmington, Del.	2½	Broken stone and sand	....	2½ × 4½ × 8¼	Sand, tar or grout	2.00
Scranton, Pa	5	Gravel, sand or 4 ins. concrete	....	2½ × 4 × 8	Tar and sand	2.10
Cincinnati, O.	3	6 ins. concrete	....	3 × 4 × 9	Coal tar	2.50
Columbus, O	7	Broken stone or concrete	....	2 × 4 × 8 to 3 × 4½ × 9	Tar or grout	1.50 to 2.25
Dayton, O.	...	6 ins. concrete	2	2¼ × 3¾ × 7⅞	Tar or grout	....
Findlay, O.	3	8 ins. broken stone, 4 ins. gravel or sand	....	2½ × 4⅛ × 8½	Coal tar	....
Massillon, O.	3	6 ins. sand	2	....	Sand and tar	....
Evansville, Ind.	3	6 ins. concrete	....	2½ × 4½ × 8½	Sand	1.70
Ft. Wayne, Ind.	1	6 ins. broken stone	2	2½ × 4 × 8½	Sand	1.55
Indianapolis, Ind.	2	6 ins. concrete	....	2¼ × 4¼ × 8¼	Tar and grout	2.40
Lafayette, Ind.	3	8 ins. gravel, 2 ins. sand, course brick flatwise	1	....	Sand	....
Terre Haute, Ind.	1	8 ins. broken stone	2	2½ × 4¼ × 8½	Grout	2.25
Detroit, Mich.	3	....	....	2¼ × 4 × 8½	Coal tar	2.00
Charleston, W. Va.	22	3½ ins. sand and tarred boards	1½	2 × 4 × 8	Sand	1.15
Wheeling, W. Va.	10	8 ins. gravel	2	2 × 4 × 8¼	Coal tar	1.35
Mobile, Ala	5	Sand and course brick flatwise	1	2⅛ × 4 × 8	Sand	1.50
Memphis, Tenn.	4	6 to 9 ins. concrete	....	2½ × 4 × 8¾	Asphalt	2.78
Louisville, Ky.	1½	6 ins. concrete	....	2½ × 4½ × 8½	Coal tar	1.65
		Western States.				
Alton, Ill.	2	6 ins. broken stone, course brick flat	1	2¼ × 3¾ × 7⅞	....	2.16
Bloomington, Ill.	18	2 ins. cinders, 2 ins. sand, course brick flat	1	2¼ × 3¾ × 7⅞	....	1.40
Galesburg, Ill.	6	6 ins. sand, course brick flat	1	2 × 3¾ × 7¾	Sand	....
Jacksonville, Ill.	4	6 ins. cinders, 1 in. sand, course brick flat	....	....	....	....
Ottawa, Ill.	2	6 ins. sand, course brick flat	....	....	....	....
Peoria, Ill.	6	6 to 8 ins. gravel or 6 ins. concrete	1	4 × 5 × 12	Sand	1.75
Quincy, Ill.	6	8 ins. broken stone, 2 ins. sand, course of brick flat	1	2½ × 3¾ × 7¾	Sand	....
Rockford, Ill.	1½	6 ins. broken stone, 2 ins. sand, 6 ins. broken stone, 2 ins. sand, course brick flat	1	2½ × 3¾ × 7¾	Sand	1.34 to 1.74
Rock Island, Ill.	4	6 ins. broken stone, 2 ins. sand, 6 ins. broken stone, 2 ins sand, course brick flat	1	2½ × 3¾ × 7¾	Sand	1.65 to 1.40
Springfield, Ill	6	6 ins. cinders	....	2 × 4 × 8	Sand	1.50
Kenosha, Wis.	½	6 ins. concrete or broken stone	1	2¼ × 3¾ × 7¾	Sand	....
Burlington, Ia.	5	6 ins. broken stone, cinders or sand, with course of brick flat	1	2¼ × 4½ × 8½	Sand	1.65
Clinton, Ia.	4	6 ins. broken stone, with sand	....	2¼ × 3¾ × 7⅞	Sand	1.35
Cedar Rapids, Ia.	..	2½ ins. sand, course brick flat	1	2¼ × 3¾ × 7⅞	....	....
Council Bluffs, Ia.	4	4 ins. sand	....	2¼ × 4 × 8	Sand	1.32
Davenport, Ia.	5	8 ins. broken stone, with sand, 6 ins. broken stone, course brick flat	....	2¼ × 3¾ × 7⅞	Sand	1.38 1.70
Des Moines, Ia.	...	4 ins. sand, course brick flat	1	2¼ × 3¾ × 7⅞	Sand	....
Dubuque, Ia.	½	6 ins. concrete	....	2¼ × 3¾ × 7⅞	Sand	1.69
Keokuk, Ia.	½	5 ins. broken stone. 3 ins. sand, course brick flat	1	2⅛ × 4 × 8	Sand	1.68
Omaha, Neb	5	6 ins. concrete	2	2¼ × 4 × 8	Sand	1.95
Hannibal, Mo.	2	4 ins. broken stone, 3 ins. sand, course brick flat	1	2 × 3¾ × 7¾	Sand	....
Atchison, Kan.	5½	4 ins. sand, course brick flat	1	....	Sand	1.65
Ft. Smith, Ark.	3	6 ins. concrete	2	2 × 3¾ × 7¾	Sand	....

Table III. gives a concise statement of the manner of laying brick pavements in a number of cities of the United States, which will render the ordinary methods of utilizing this material quite readily understood.

ELECTRICITY IN MINING.*

It is roughly estimated that some 300 companies in the United States engaged in mining and the kindred arts now employ electricity in their operations. As all these plants have been installed within the last few years, it is evident that mining engineers have been quick to appreciate the great advantage of the use of electricity and adopt it for their many requirements. In underground workings the chance of accident resulting in loss of life and destruction of property is, at the best, great. Humanity and economy both demand that any means that will secure greater safety should be eagerly grasped. It is an established fact that to add to the comfort and facilitate the work of the miner is to diminish financial risk and increase profits.

Electricity tried under the arduous conditions of mining service has been shown to be peculiarly efficient, safe and reliable. It presents a system of the greatest simplicity, completeness and flexibility, permitting power from one source to be distributed in units of any desired size and for any purpose to the places where it can be employed to the greatest advantage, thereby securing the minimum consumption of power and expenditure of labor. With electricity there is neither friction, heat nor condensation. There is no leakage nor loss of power when not in use, which especially recommends it for intermittent work. It is not affected by heat or cold, and does not vitiate the air, as is the case with steam and compressed air. The rapid deterioration of timbering, a source of great expense in all mines, due to bad air and heat, is, to a great extent, obviated. It has been urged against electricity that it increased the risk of fire. As a matter of fact it greatly decreases it, as the statistics of insurance companies testify. With proper safety devices and a system of concentric wiring it is practically impossible to start a fire from the current. To the engineer accustomed to speed indicators, pressure gages and indicator cards electrical methods of measurement seem particularly simple. The work being done by motor or generator at any instant can be read directly from a scale, and, if desired, automatically recorded. If necessary, motors can be controlled from a distance without difficulty.

The prime source of power is first to be considered. By conversion into electrical energy, water power, even at a considerable distance from the mine or mill, can be made valuable for all purposes, and steam power can be so located as to secure fuel and water cheaply. In addition to this, one large engine costs less, is more evenly loaded, requires less attendance, and is necessarily more efficient than a number of small ones. The introduction of electricity has in this way made important reductions in the costs of power, and there are cases in which it would be impossible to run without its help. An example is furnished by the Virginius mine at Ouray, Colo.; 300 HP. is carried at 800 volts from a water power four miles distant. The cost of coal at the mine was formerly $18 per ton, which would amount, for the present plant, to about $80,000 per year, equaling the total cost of the electric plant. The item of fuel was a complete saving, the expense of operating the steam and electric plant being about the same in other respects. Several mines in Colorado are operated by electricity that could not be operated by steam on account of their situation on the face of precipitous cliffs, up which the transportation of water and fuel would be nearly impossible. The character of the country over which the power had to be carried for the Virginius plant is exceedingly rough. A portion is at an elevation of 12,700 ft. above sea-level and well above the snow line.

Electric Generators.—Generators can now be obtained of any size and designed to run at any reasonable speed for belting or direct connection to engines or water-wheels. The largest generator in the world is now running in the power station of the intramural electric railway at the World's Columbian Exposition, in Chicago. It is of 2,000 HP., and directly connected to a compound condensing engine running at 75 revolutions. The electric generator is substantially the same as the motor, and both can be relied upon to give an efficiency of from 90 to 95%.

Electric Power Transmission and Distribution.—The cost of copper with any fixed loss, power and distance varies inversely as the square of the voltage. It is, therefore, evident that as high a voltage as possible should be used if economy of copper alone is to be considered. When the power is carried over long distances the cost of copper is the largest item of expense. For general distribution, especially underground, convenience of insulation and handling are of more importance and call for a low potential. Nearly all the plants now in operation are supplied with current at 220 or 500 volts. There are a number, however, in which voltages of 1,000 and over are in use; notably at the Poorman, Comstock and Calumet & Hecla mines. When bare wires are used, as for haulage, we are limited to a potential of 500 volts. Direct current generators are confined, by difficulties of construction, to potentials of less than 1,500 volts. The distance over which direct current can be economically carried at this potential is about four miles. Above this point alternating currents are used.

The long distance transmission of power was first brought prominently before the public by the experimental line constructed between Lauffen and Frankfort two years ago. The power of the Lauffen Falls was converted into electricity, transmitted 115 miles to the exposition at Frankfort, and there operated a number of motors. The distance was beyond the limits of commercial success, but it demonstrated the possibility of the system. To-day plants are in operation and transmitting current for light and power at Walla-Walla, Hartford, Portland, Pomona and Telluride. The distances vary from 4 to 13 miles.

Alternating currents are particularly desirable on account of the ease with which the electrical pressure can be changed. By means of transformers without moving parts the high potential used for transmission is converted into low pressure for distribution. Alternating generators are wound for as high as 5,000 volts, but it will probably be found better to limit them to 2,500 volts. This potential permits of economical transmission to a distance of seven or eight miles. Above that distance step-up and step-down transformers are used. At present we do not care to go above 10,000 volts, which places the limit of about 25 miles to practical work. Alternating current motors possess nearly the same properties as those built for direct current. They have the advantage of being commutatorless, but cannot be so heavily overloaded as a series wound direct current motor. They are, therefore, not as suitable for railway or hoisting service. Direct current can, however, be readily obtained from alternating by means of a rotary transformer which is a combined alternating motor and direct current generator. Motors have been designed to meet all the special requirements of mining work, and I will give a short description of some of the more recent applications.

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*Abstract of a paper by F. O. Blackwell, presented before the American Institute of Mining Engineers, at the Chicago meeting, which formed a part (Division C) of the International Engineering Congress, August, 1893.

Electric Haulage.—In no application of electricity except lighting has such success been met with as in the operation of railways. Above ground it has already supplanted animal power, and in many cases steam. For underground haulage the ready control, compactness and freedom from smoke render it still more desirable, and already electric locomotives are in some 30 mines. I would call particular attention to the saving that can be effected in the size of entries. The electric locomotive is so designed as to occupy no more space than the car which it is to haul. With any other method of traction considerably more height or width is necessary. In coal mines in which there are narrow seams, this is especially noticeable, as much rock has to be blasted away to admit of the passage of mules. By using electric locomotives the blowing down of the roof is entirely done away with. The increased speed also permits a larger tonnage to be taken from the same outlet and with fewer turnouts, switches and cars. Locomotives are now to be obtained of any size and to operate on any track gage not less than 18 ins. The Baltimore & Ohio R. R., after carefully considering all systems, decided to equip the tunnel through Baltimore with electricity, and push through all the trains by electric locomotives. The first of these locomotives is now nearly completed at the Schenectady works of the General Electric Co. Its weight is 90 tons, and at 15 miles per hour it will develop 1,500 HP. Another locomotive of 30 tons weight is used for surface railways. A motor drives each axle, no gearing being required. For mining haulage large sizes are not required: those now in use varying from 150 to 10 HP., the most common size being 30 HP. At Rock Springs, Wyo., there is in operation a locomotive of 80 HP. It is operated by a single motor, geared to both axles, the connection to the axles, however, being made through a flexible coupling, allowing the entire weight to be supported on springs. No part of the machine is wider or higher than the wheels. The larger sizes of locomotives generally are constructed with one motor, and the smaller with two. All locomotives in use are controlled by rheostats, and the speed under load varies from 6 to 12 miles per hour.

Electric Hoisting.—Electric hoists are now largely in use and follow as nearly as possible the methods and construction approved for steam hoists. The governing mechanism is similar, rheostats replacing the steam controlling gear, and the brakes and clutches are the same. The rotary motion of the motor avoids the use of connecting rods entirely. If it is desired to lower by power the current can be admitted to the reversed motor. For small hoists used in winze and timber construction work, electricity is well adapted, the power connection being easily and quickly changed. The simplicity of the application of electricity and the consequent economy is well exemplified in the equipment of the Brooklyn, N. Y., docks of the Wilson steamship line. Nine electric hoists, constructed by the General Electric Co., have been in continuous operation for two years with a total cost of repairs of $23. The double drum hoist is designed for a double compartment shaft, and is furnished with post brakes and jaw clutches of the ordinary pattern. Special hoists for use underground are equipped with iron-clad motors so as to be thoroughly protected. An efficiency of from 50 to 60% is usually obtained between the power taken by the motor and the foot-pounds hoisted.

Electric Pumping.—A number of large pumping plants are now in operation equipped with electric motors. It is necessary in order to turn the reciprocating motion of a plunger pump into rotary, to equip it with crank shaft and connecting rods. This at the same time insures a steady flow of water. Some difficulty is experienced in cutting down the speed of electric pumps as is done with steam. The general practice has been to stop and start in order to decrease the capacity. The best method, and one going largely into use, is to make the fields of such strength as to give the minimum speed desired, so that by decreasing the current in them the speed may be increased up to a maximum output. Where many pumps are in operation of nearly the same size a convenient method of regulation is to throw the pumps into multiple series combinations with each other. They may also be controlled by varying the electromotive force supplied them from the generators. Rheostats answer well enough for small pumps. Triplex single-acting and duplex and triplex double-acting all work well and give an efficiency of over 70% between the electric power taken by the motor and the water delivered by the pumps. If the lift is small and the water contains much solid matter, centrifugal pumps may be used, but their efficiency is low. At the World's Columbian Exposition exhibit of the General Electric Co. is shown a Blake pump directly connected to a slow speed multipolar motor of 100 HP., requiring only one gear reduction. The capacity of the pump is 500 gallons at 500 ft. head. A sinking pump of 120 gallons capacity to work against 200 ft. head has been made, the motor and gearing being completely inclosed in a cast steel case, and cannot be damaged by being flooded.

Electric Air Compressors.—The statements made above regarding hydraulic pumps apply equally well to air compressors, except that as air has not the inertia of water it can be automatically loaded and unloaded without throwing any strains on the mechanism, the motor running constantly at a fixed speed. A decided saving of power can be effected by locating drill compressors near to the drills, and thus avoiding losses by leakage and shrinkage in the pipes.

Electric Drilling.—Although it has been a matter of great difficulty to make an electric percussion drill which would stand the continual abuse and hard usage to which air drills are subjected, they are at present in constant and successful operation. By care in designing the coils so as to make them fireproof and rigid they have been made to stand the strain. The drill consists of an outer iron pipe casing inside of and attached to which are two coils and the ratchet mechanism. The plunger, equipped with the ordinary chuck and rifle nut, is in the center of the coils. The coils are supplied with current alternately, and draw the plunger up and down at a speed fixed by the generator which supplies the current. Electric diamond drills are in use for drilling solid holes and for removing cores for prospecting purposes. For prospecting both above and underground the electric drill is particularly available, as it is extremely light and compact, and temporary wires can be run to places where it would be difficult to carry steam pipes or boilers. A diamond prospecting drill with hoist and pump, driven by a 2¾ HP. motor, will remove a 1⅜ core, and can drill 600 ft. deep without difficulty.

Electric Coal Cutting.—Electric coal cutters are now largely in use in the bituminous mines. In the machine most employed the coal is undercut by means of bits set in a rotary bar on the end of a sliding frame which is fed into the face of the seam. Other cutters are constructed with a sprocket chain, to the links of which are affixed cutting tools. Machines of this kind can be fed either in or along the face of the coal for long wall or room working. In both of these the electric motor is built into and forms part of the frame, adding but little to its weight. In exceedingly hard or pyritiferous coals, which cannot be cut with a continuously moving cutter, an electric pick machine is advantageously used. This also has the advantage of giving a kerving wider at the front than at the back of the cut, which allows the coal to fall outward and more lump coal to be gained. In a pick machine of this kind, made by the General Electric Co., the motor draws a projectile back against a spring, and, releasing it, lets the pick fly against the face of the coal at the rate of 150 blows a minute. Electric drills for putting in holes, for blowing down coal after it has been undercut or from the solid, as is done in anthracite, are also used. Mounted on a column a machine of this kind is free to drill in any direction from horizontal to vertical. A drill of this type, of 100 lbs. weight, will easily drill a 1½-in. hole at the rate of 6 ft. per minute in hard or soft coal.

Ventilating.—It is often desirable, in order to obtain the best results from fans and blowers, to locate them at the most distant points from the surface. This is done more easily by electricity than by any other power, and the blowers can be readily advanced as the workings are pushed deeper. The electric motor is especially suitable for high-speed blowers, which are efficient and occupy but small space. Much saving in piping can also be effected by using higher velocities and forcing air out from the inside rather than sucking it from the surface. Fans can be controlled by a shutter on the outlet pipe or the speed of the motor may be varied.

Electric Lighting.—It has been found that much more work can be gotten from men by giving them better illumination. By avoiding the use of oil lamps and candles the air is left purer, and both time and power saved by doing work underground which would otherwise have to be done on the surface. Electric lighting also reduces the risk of accident by calling attention to conditions which would otherwise pass unnoticed. In gaseous mines, where many explosions have resulted from the reckless use of miners' lamps, electric lighting is invaluable.

Metallurgy.—It is impossible to go fully into the electro-metallurgical and electro-chemical processes now in use. The refining of black and blister copper has reached large proportions, fully one-third of the copper refined in this country being electrically treated, and considerable quantities being shipped abroad. By this process gold and silver are obtained from the matte, the recovery of which would be impracticable by any other method. Gold, silver and lead are also beginning to be refined electrolytically. Aluminum and silicon are gotten almost exclusively by electric smelting and reducing. Caustic soda, sodium, chloride of lime, and vermilion are commercially obtained by electrolysis.

I have not, within the scope of this paper, been able to deal with all the many and constantly increasing applications of electricity, but enough has been said to make evident its far-reaching importance to the mining industry.

THE NEW UNITED STATES STANDARD SHEET METAL GAGE.

The Bureau of Weights and Measures of the Treasury Department has officially announced the new sheet metal gage adopted by act of Congress, approved March 3, 1893, as "the only standard gage for sheet and plate iron and steel in the United States of America." We reprint it herewith in full. It will be noticed that the dimension on which the numbers of the gage are based is the weight per sq. ft. in ounces avoidupois. The thicknesses corresponding to the various numbers are calculated approximately only. The new gage differs at every point from every one of the other standard gages which are in common use, and the difference at many points is very considerable. The law declares that "this gage and no other is to be used in fixing duties and taxes levied by the United States on sheet and plate iron and steel," and that in the practical use of the standard a variation of 2½% either way may be allowed.

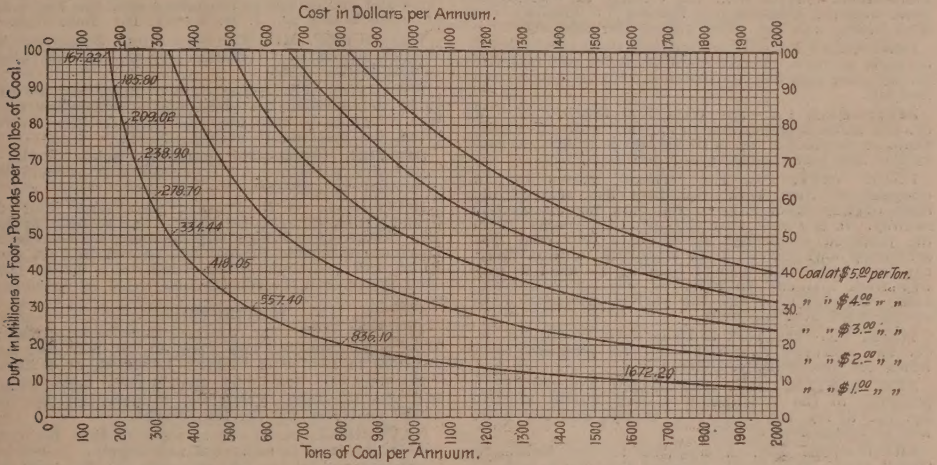
The New U. S. Standard Gage for Sheet Iron and Steel.

No. of gage.	Approximate thickness.		Weight per sq. ft.			Weight per sq. meter.	
	Ins.	Mm.	Oz.	Lbs.	Kilos.	Kilos.	Lbs.
0000000	.5	12.7	320	20.00	9.072	97.65	215.28
000000	.46875	11.90625	300	18.75	8.505	91.55	201.82
00000	.4375	11.1125	280	17.50	7.983	85.44	188.37
0000	.40625	10.31875	260	16.25	7.371	79.33	174.91
000	.375	9.525	240	15.	6.804	73.24	161.46
00	.34375	8.73125	220	13.75	6.237	67.13	148.00
0	.3125	7.9375	200	12.50	5.67	61.03	134.55
1	.28125	7.14375	180	11.25	5.103	54.93	121.09
2	.26562	6.74687	170	10.625	4.819	51.88	114.37
3	.25	6.35	160	10.	4.536	48.82	107.64
4	.23437	5.95312	150	9.375	4.252	45.77	100.91
5	.21875	5.55625	140	8.75	3.969	42.72	94.18
6	.20312	5.15937	130	8.125	3.685	39.67	87.45
7	.1875	4.7625	120	7.5	3.402	36.62	80.72
8	.17187	4.36562	110	6.875	3.118	33.57	74.00
9	.15625	3.96875	100	6.25	2.835	30.52	67.27
10	.14062	3.57187	90	5.625	2.552	27.46	60.55
11	.125	3.175	80	5.	2.268	24.41	53.82
12	.10937	2.77812	70	4.375	1.984	21.36	47.09
13	.09375	2.38125	60	3.75	1.701	18.31	40.36
14	.07812	1.98437	50	3.125	1.417	15.26	33.64
15	.07031	1.78593	45	2.812	1.276	13.73	30.27
16	.0625	1.5875	40	2.5	1.134	12.21	26.91
17	.05625	1.42875	36	2.25	1.021	10.99	24.22
18	.05	1.27	32	2.	.9072	9.765	21.53
19	.04375	1.11125	28	1.75	.7938	8.544	18.84
20	.0375	.9525	24	1.50	.6804	7.324	16.15
21	.03437	.87312	22	1.375	.6237	6.713	14.80
22	.03125	.79375	20	1.25	.567	6.103	13.46
23	.02812	.71437	18	1.125	.5103	5.493	12.11
24	.025	.635	16	1.	.4536	4.882	10.76
25	.02187	.55562	14	.875	.3969	4.272	9.42
26	.01875	.47625	12	.75	.3402	3.662	8.07
27	.01718	.43656	11	.687	.3119	3.357	7.40
28	.01562	.39687	10	.625	.2835	3.052	6.73
29	.01406	.35718	9	.562	.2551	2.746	6.05
30	.0125	.3175	8	.5	.2268	2.441	5.38
31	.01093	.27781	7	.437	.1984	2.136	4.71
32	.01015	.25796	6½	.406	.1843	1.983	4.37
33	.00937	.23812	6	.375	.1701	1.831	4.04
34	.00859	.21828	5½	.343	.1559	1.678	3.70
35	.00781	.19843	5	.312	.1417	1.526	3.36
36	.00703	.17859	4½	.281	.1276	1.373	3.03
37	.00664	.16867	4¼	.265	.1205	1.297	2.87
38	.00625	.15875	4	.25	.1134	1.221	2.69

That the new gage will replace the other gages which are now in common trade use does not seem probable. Fixing gage numbers by variation in weight is doubtless convenient for the Customs officials; but the maker and user of sheet metal is accustomed to measuring thicknesses, not testing them by weighing, and the micrometer gage is a much more convenient tool than the balance. The new gage promises, therefore, so far as we can see, to merely add another element to the confusion of gages which already exists; and the hoped-for common standard on which all makers and users of sheet metals can unite seems as far off as ever.

THE COMPARATIVE COST OF PUMPING WATER WITH ENGINES OF VARIOUS RATES OF DUTY.

In our issue of Dec. 22, 1892, we discussed at length the relative economy of high-duty pumping engines compared with those giving lower rates of duty, and pointed out the fact that the saving by increase of duty falls off very rapidly after a reasonably high efficiency is reached. We are indebted to Mr. John W. Hill, M. Am. Soc. C. E., of Cincinnati, for the accompanying diagram, which shows this fact and others of interest in connection with the relative cost of pumping water with engines of varying economy and fuel of varying price. The diagram is, moreover, of practical use to every designer of water-supply systems as an aid in computing the engine duty which will give the least total annual cost. It was, in fact, plotted by Mr. Hill for his own use in this work.



ANNUAL COST OF COAL USED IN PUMPING 1,000,000 GALLONS OF WATER DAILY AGAINST A HEAD OF 100 FT. WITH ENGINES OF VARIOUS RATES OF DUTY.

(Allowance for loss by friction, slip, etc., taken at 10%.)

The only improvement we can suggest on the diagram is its extension in each direction. Pumping engines are now in the market which will give duties considerably above 100,000,000 ft.-lbs. per lb. of coal; and on the other hand there are many cities west of the Rocky Mountains which are paying $5 per ton or more for coal and using pumping engines which cannot show even 40,000,000 ft.-lbs. duty in daily service.

Bids for constructing the highway bridge over the Harlem River in New York city were opened on Aug. 29, but as there are 118 items to each bid it will be some days before the contract is awarded. The bidders were M. S. Coleman, John J. Hopper, Rodgers & Farrell, Hart, Anderson & Barr, Andrew Onderdonk, Stewart & McDermott, Clinton Stephens and Sooysmith & Co. The total cost of the bridge will be $1,250,000 exclusive of approaches.

The Mackaye Spectatorium, writes Messrs Jenney & Mundie, the well known architects of Chicago, is not to be taken down as was erroneously reported in the newspapers of Chicago. This was not simply a World's Fair enterprise, but was intended as a great summer theatre, where would be produced the finest music and the most realistic spectacular performances ever put upon an American stage. It is the intention of its promoters to complete and open the building by June of 1894. Mr. Steele Mackaye has many patented inventions applied to the proposed work and he has had made a complete working model of the entire stage on a scale of 1-24 natural size. As stated in our article of Aug. 24, Mr. Ralph Modjeski was the engineer of the tank and stage proper, but all other architectural and engineering work was designed by and built under the superintendence of the architects, Messrs. Jenney & Mundie.

More Fourth Assistant Examiners are wanted in the United States Patent Office, and the "eligible" list on the books of the Civil Service Commission is not sufficient to meet the demand. The Commission, therefore, invites applicants for the position to present themselves for the examination, and offers in addition to the regular dates and places of examination to meet applicants in Boston, New York, Philadelphia, Detroit, Chicago, St. Louis and Omaha. The salary is $1,200 per annum, and there is the prospect of promotion to higher grades. Further information may be obtained by addressing the United States Civil Service Commission, Washington, D. C.

The Bruges-Heyst maritime canal, discussed for some years past and intended to unite Bruges with the North Sea, is thus described by a technical commission lately appointed by the Belgian government: The canal would strike the sea about one mile south of the town of Heyst. It would be perfectly straight, 8 miles long, 72 ft. wide on the bottom, and 246 ft. wide on the surface and 26¼ ft. deep at low tide. At Heyst there would be a curved protecting pier 1,968 yds. long, rising to a height of 42 ft. above low tide. The government has promised to accord a subsidy of $5,000,000; the Provincial Council of West Flanders voted, on June 13, 1893, $400,000 for the canal, and on June 19, 1893, the city of Bruges voted $1,450,000 for the same purpose. As the highest estimated cost is about $8,000,000, Mr. John B. Osborne, U. S. Consul at Ghent, says its construction is assured.

A rainfall of 3.81 ins. in 12 hours, as the result of the storm of the night of Aug. 23, beats all previous records at the government observatory in this city for the same period. The storm was the western edge of a West Indian hurricane. In New York the maximum velocity of the wind was about 38 miles per hour; but at New London, Conn., 50 miles were recorded, and from Block Island comes a record of 90 miles per hour; but the latter was unofficial.

CONSTRUCTION NEWS

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & POTOMAC.—It is stated that an extension of the Pope Creek line from Cox's station to Chapel Point, on the Potomac River, a distance of about five miles, is being considered.

BURTOUCHE & MONCTON.—This road, between Burtouche and Moncton, N. B., a distance of 32 miles, is reported to have been purchased by Louis G. de Bertram, Pres., New York, representing New York capitalists, who will put it in first-class condition as soon as possible and operate it regularly after next month.

SANDY RIVER.—When this road was built between Farmington and Phillips, Me., a distance of 18.5 miles, there were 74 bridges on the line, according to the Phillips "Phonograph." These have been replaced by granite culverts until but 18 remain and eight more have been selected to be dispensed with next season. The road will soon have a new engine and is being improved in many ways.

Projects and Surveys.

BOSTON & NOVA SCOTIA COAL.—Press reports state that the Nova Scotia government has decided to grant a subsidy of $3,200 to this company to build a railway from its coal mines at Broad Cove to Orangedale, a distance of 35 miles, there to connect with the Intercolonial railway system. The company has the promise of a similar subsidy from the Dominion government. The contract for this road has been awarded to Garson, Purcell & Co., St. Catharines, Ont., as stated in our issue of Aug. 3.

INDIANAPOLIS, BLOOMINGTON & BEDFORD.—W. M. Denniston, Cy. Clk., Bedford, Ind., writes us that nearly every township on the line of this proposed road has voted it aid. The road will extend from Indianapolis to Bedford through the oolitic limestone quarries of Lawrence and Monroe counties. Newell Sanders, Pres., Chattanooga, Tenn.

Southern.—Existing Roads.

AUGUSTA SOUTHERN.—Surveys will soon be made for changng this road to standard gage. This was until February, 1893, the Augusta, Gibson & Sandersville and extends from Augusta to Sandersville, Ga., a distance of 80 miles. The gage is 3 ft. and 30-lb. steel rails are used. The Sandersville & Tennville road has been leased and a third rail will be laid at once so that through trains can be run from Augusta to Tennville, Ga., where a connection is made with the Central R. R. of Georgia. Wm. Bailey, Gen. Man., Augusta, Ga.

MOUNT CARBON COAL CO.—It is reported that a contract was awarded Aug. 26 for a short railway near Charleston, W. Va., to connect the mines of this company with the Chesapeake & Ohio R. R.

NASHVILLE & KNOXVILLE.—This road has been built from Lebanon to Standing Stone, Tenn., a distance of 55 miles, and efforts are now being made to complete the line to Harriman, Tenn., 60 miles from Standing Stone. Jere Baxter is pushing the project.

SOUTH FLORIDA.—The lower section of this road between High Springs and Blue Springs has been complted.——The right of way has been secured over the Florida Central & Peninsular road between Archer and Early Bird, 20 miles, and the road is being rebuilt.

Projects and Surveys.

ALABAMA.—The Dothan "Siftings" states that a company is being organized which will build a railway between Dothan and Columbia, Ala., and that the construction will be commenced within three months if the citizens along the line of the road will subscribe $25,000.

Northwest—Existing Roads.

DULUTH, MESABA & NORTHERN.—The Duluth "Evening Herald" states that Wolf & King are pushing work on the Lake Superior mine extension of this road and expect to finish the contract about Sept. 15. Between 700 and 800 men are now employed, at $1.50 per day for common labor. This branch extends from Ore Junction, now called Wolf, to the Superior mines, a distance of 18 miles. With the completion of this extension Wolf & King will have built 45 miles of railway this summer.

Southwest—Existing Roads.

GALVESTON & WESTERN.—Wm. Selkirk, Secy., Galveston, Tex., informs us that this company is not yet ready to commence proposed extensions owing to the present unsettled financial condition of the country. The Dallas "News," however, has the following: This company has secured authority to construct a bridge across the bay at Galveston, Tex., and has received a proposition from the Houston, East & West Texas Ry. to purchase the North Galveston, Houston & Kansas City road, extending from Virginia Point to North Galveston, and to extend it to Houston. W. W. Wambaugh has begun surveys for the bridge at Virginia Point. The work of securing right of way for the proposed extension by way of Bolivar Point to Beaumont will soon be commenced, and it is expected to begin construction this fall.

KANSAS CITY, PITTSBURG & GULF.—A director of this road is reported as stating that it is the intention to build the road to the Gulf of Mexico, connecting at Shreveport, La., with the New Orleans & Galveston, and that the money is all secured for building as far as Fort Smith, Ark., to which city it is expected to be operating by next January. The road is now in operation from Kansas City south to Pittsburg, Kan., a distance of 136 miles, and the section from Pittsburg to Joplin, Mo., 30 miles, is expected to be completed this month.

PEORIA, DECATUR & EVANSVILLE.—The consolidation of the Peoria, Decatur & Evansville R. R. Co. and the Chicago & Ohio River R. R. Co. was recorded last week in Illinois. The consolidated road is to be known as the Peoria, Decatur & Evansville Ry. Co.; principal office at Peoria; capital stock, $8,500,000; directors, J. M. Devean, Herman Clark, C. C. Baldwin, H. J. Nicholas, D. J. Mackey, J. S. Stevens, E. P. Huston, E. O. Hopkins, M. J. Lewis.

ST. LOUIS, KEOKUK & NORTHWESTERN.—A press dispatch from St. Louis states that the work to be done with the $12,000,000 of increase of stock is well under way and will be completed by next February. It consists of the building of a double-track connection between St. Louis and Alton, and two large bridges, one over the Missouri River at Bellefontaine Bluffs and the other over the Mississippi River at Alton; also new freight depot and suburban passenger depot and switch yards. The road is controlled by the Chicago, Burlington & Quincy R. R. Co.

SHERMAN, SHREVEPORT & SOUTHERN.—F. W. Fratt, Gen. Man., Greenville, Tex., writes us that this company had serious intentions of extending its line to Shreveport, La., but that the closeness of the times has caused it to abandon the idea for the present. Nothing has yet been done in the way of making surveys or determining the most practicable route.

TEXAS MIDLAND.—We are informed that this company has run three lines from Roberts to Paris, Tex., but that no selection has yet been made for the construction and no right of way has yet been procured.

Projects and Surveys.

MISSOURI.—Dr. G. W. E. Chamberlain, Rockport, is reported as having raised $45,000 to secure the building of a narrow gage road between that city and Tarkio, a distance of nine miles. It is stated that the road will be constructed at once.

Rocky Mt. and Pacific—Existing Roads.

BURLINGTON & MISSOURI RIVER.—The grading on the extension to Pass Creek, on the Montana state line, a distance of about 25 miles northwest of Sheridan, Wyo., has been completed. The track has been laid only a part of the distance and the construction is reported as temporarily suspended.

NELSON & FORT SHEPPARD.—The grading of this road from Nelson, B. C., to connect with the Spokane Falls & Northern at the international boundary line, a distance of 60 miles, is practically completed to the crossing of the North Fork, 30 miles from Nelson, where a 1,000-ft. siding is being put in. Tracklaying has been commenced at Boundary City and it is expected that the road will be in Nelson by October.

SOUTHERN PACIFIC.—The extension from Burbank to Chatsworth, Cal., is practically completed and the road will be opened to traffic within a few weeks. The line is 27 miles long and it is thought that it will ultimately be extended across the Santa Susanna Mountains and down the Simi valley to a junction with the main line near Venture.——The rumor that 1,000 persons have been discharged by the contractors at the tunnels at Santa Margarita is claimed to be incorrect. About 1,200 were at work on the tunnels and grades. The work is about half completed and 400 men engaged in grading were discharged in order that the tunnels may be finished at the same time as the grading. There are seven tunnels to be built, the largest being about two-thirds completed. These are expected to be finished and the road completed to San Luis Obispo by next February.

Projects and Surveys.

COLUMBIA RIVER & ASTORIA.—According to press reports a party of Eastern capitalists have taken hold of this projected railway in Oregon, and it is proposed to have the line from Astoria to Goble, on the Northern Pacific, under construction before the end of the year. It will be 58 miles long and follow the course of the Columbia River, probably using the Northern Pacific tracks from Goble into Portland. J. C. Stanton, one of the New York capitalists interested, is reported to have said that the company has been granted the right of way through the town and 1½ miles along the water front by the citizens of Astoria, and that the landowners between Astoria and Goble are likely to guarantee a land subsidy valued at $2,000,000. The capital stock is $2,000,000 and the proposed bond issue $2,000,000. The line when completed will have the choice of three railway connections at its eastern terminus.

GILSONITE ASPHALTUM CO.—It is reported that the Gilsonite Asphaltum Co., St. Louis, has plans prepared for building 90 miles of railway in Utah, from the Rio Grande Western road northwest to rich asphaltum and mineral fields, as soon as this region, reported as containing 4,000,000 acres, has been thrown open to settlement. U. S. Senator Vest, of Missouri, is a stockholder of this company.

HELENA, WHITE SULPHUR SPRINGS & CASTLE.—The Helena "Independent" states that R. A. Harlow has completed arrangements for the construction of this road, now called the Montana Midland, from Helena to Castle, Mont., a large mining camp in Meagher county, 80 miles east of Helena. The preliminary survey was made a year ago by Gen. W. A. Hazen, who is now definitely locating the line. The road is to connect with the proposed Burlington & Missouri River extension through Castle to Great Falls. Arrangements have already been made for grading the line between Helena and the Missouri River.

SALT LAKE & WYOMING.—The "Salt Lake Tribune," Salt Lake City, states that W. S. Martin and Al Thompson have a surveying party out locating the old line of this road. They will complete the survey of the Silver Creek grade. The line was first surveyed and graded by Fulton & Bates, who expended about $60,000 on it and afterward allowed their title to run out. It was located and surveyed by the company of Salt Lake City capitalists who own it now. The title expired last week for want of enough work being done and the line is being relocated. The surveying party is under Major Wilkes.

UTAH.—The secretary of the chamber of commerce, Salt Lake City, has received a communication from parties who propose to build a railway from the coal fields of Chalk Creek to Salt Lake City and thence to the coast of California. If a sufficient bonus is voted the construction will be commenced within 60 days, according to the letter received.

Foreign.

TOPOLOBAMPO.—A dispatch from the city of Mexico to the St. Louis "Globe-Democrat" states that the maps and profiles of the first section of this railway, the concession for which is held by A. K. Owen, who is at the head of the Topolobampo Co-operative Colony, in the State of Sinaloa, have been approved by the Department of Communication and Public Works. The department has also approved the map of the general route of the line, 250 miles from Topolobampo Harbor to the summit of the Sierra Madre, which secures the only surveyed route through the Sierra Madre Mountains of southern Chihuahua that has yet been found practicable for a little road. The work on the railroad was formally inaugurated under the new concession June 10 last, in the presence of the Prefect of Fuerte and a gathering of the colonists.

SALVADOR.—A press dispatch states that the U. S. Consul at San Salvador has reported to the State Department that two American citizens, Frank M. Crawford and A. J. Moissant, both of San Francisco, have made separate propositions to the Salvadoran Congress for the construction of a railway between Salvador and the seaport of La Libertad. Mr. Moissant's proposition will be accepted, the consul says, on the basis of the outlay of $550,000, on which the government guarantees 6% interest.

STREET RAILWAYS.

LAWRENCE, MASS.—The South Side St. Ry. Co. is being organized to build a railway along the south bank of the Merrimac River through the towns of Andover and Tewksbury to Lowell, a distance of nine miles; capital stock, $90,000; M. E. Clemens, Winslow Goodwin, Andover; C. T. Guild, North Attleboro; A. C. Russell and others; Lowell; W. S. Knox, Lawrence.

STERLING, MASS.—Harold Parker and F. W. Bateman have been in town making preliminary surveys for the proposed Melendy electric railway from Clinton to Sterling Junction, according to reports.

NEW BRITAIN, CONN.—The Central Ry. & Electric Co. is preparing to extend its line to Berlin, the citizens of Berlin being reported as in favor of the project.

NIAGARA FALLS, N. Y.—Captain Brinker, Buffalo, one of the promoters of the Niagara Falls & Lewiston Electric R. R., is reported as stating that the construction of the proposed road will be commenced about Oct. 1. Almost the entire right of way has been secured, and the road is expected to work in conjunction with the Buffalo & Niagara Falls Electric Ry., making a continuous electric railway between Buffalo and Lewiston.

CARLISLE, PA.—The council has granted the right of way to the electric railway company represented by W. J. and S. R. Ickes and O. H. Ormsby, Altoona. The construction is to be commenced by next April, three miles of road be laid by next July and the line completed by July, 1895, including a branch line to Boiling Springs.

CHESTER, PA.—The council has granted several electric railway privileges. Fifth St. was given to the Media, Middletown, Aston & Chester line, giving that road an entrance into the heart of the city; sixth St. to the Philadelphia & Delaware, connecting the Philadelphia system with the Chester & Wilmington lines, and the People's line running to Rockdale and Glen Riddle was also given rights over this street.

FRANKLIN, PA.—It is reported that surveys will be made at once for the Franklin & Oil City Electric St. Ry. and that the construction will be commenced this fall.

PITTSBURG, PA.—The West End Electric St. Car Co. has made a proposition to extend its line to Castle Shannon provided a bonus of $30,000 is raised. A canvass is now being made to secure this sum.

UNION CITY, PA.—The "Times" states that a company of New York capitalists has secured the right of way from Erie to Edinboro for an electric railway. It is stated that the road will connect with the proposed Cambridge & Edinboro line, and that eventually it will extend from Meadville to Erie. There has been some talk also of building an electric railway from this city to Erie, by way of Wattsburg, Lake Pleasant, etc., and the parties interested have already been over the route.

YORK, PA.—The York & Dallastown Electric R. R. Co. has surveyed two routes for its proposed road, which are now being considered.

NEW CASTLE, DEL.—The council has granted a franchise to the Wilmington & New Castle Electric Ry. Co. to lay tracks on four streets and the work will be commenced at once.

FREDERICK, MD.—A dispatch to the Baltimore "Sun" states that C. D. Elridge, Myersville, and E. J. Smith, Frederick, have been employed by a company of private capitalists to survey a route between Myersville and Boonsboro' and Boonsboro' to Keedysville, Washington Co., on the Baltimore & Ohio, with a view of extending the Frederick & Middletown Electric Ry. to those places. It is said that capital is now being enlisted from prominent Northern financiers to build the extension. C. F. Flook, Myersville, who is interested in the extension, is reported as saying that the ultimate terminus of the road will be Hagerstown. The contract for the first eight miles of this road has been awarded to the Hughes & Rigby Engineering Co., as stated in our issue of July 27.

OWING'S MILLS, MD.—A company is being organized with a proposed capital stock of $100,000, to build an electric railway about ten miles long. It is to run from Pikesville along the Riesterstown turnpike to Reisterstown, and thence through private property to Glyndon and Emory Grove. A single track will be laid, with sidings every mile. The road will be equipped with four electric cars, similar in size and construction to the large cars in use on the Lake Roland elevated line, Baltimore. The power house will be built at this place, where ample water power can be had. The road is expected to cost about $98,000, and be completed by next spring. Alex. Y. Dolfield is interested.

COLUMBUS, O.—The only bid received for a street railway franchise on West Mound St. was that of the Columbus & Harrisburg Electric St. Ry. Co. The road would be built from High St. to the city limits and thence to the village of Harrisburg. The bid was rejected on account of indefiniteness.

CUYAHOGA FALLS, O.—The council has passed the second reading of the ordinance granting a franchise to the Cuyahoga Falls & Akron Electric Ry. Co. The consent of a majority of the property owners with frontage on the proposed route has already been secured.

PIQUA, O.—The last rail of the Miami Valley Electric Ry. between this city and Troy was laid Aug. 23. It is reported probable that the line will be extended to Dayton as soon as the financial depression is over.

SAGINAW, MICH.—An electric railway is projected between this city and Bay City, a distance of 11 miles, according to press reports.

BELLEVILLE, ILL.—The General Electric Co. has been given six months in which to build an electric railway in this city, provided $10,000 is expended on the tracks within 60 days.

BUNKER HILL, ILL.—A committee has been appointed to raise $300 to pay the cost of a survey through this city for a proposed electric railway from Waggoner, in Montgomery Co., to the Alton bridge. H. H. Fisher is manager of the railway company.

CEDAR RAPIDS, IA.—The "Gazette" states that a movement is on foot to build an electric street railway from Charles City to Shell Rock.

FREEPORT, CAL.—It is reported that plans are being made for an electric railway between Sacramento and Walnut Grove by way of this place.

SANTA MONICA, CAL.—C. M. Stewart is about ready to receive bids for grading for a proposed electric railway, according to reports.

HIGHWAYS.

NEW JERSEY.—The freeholders of Mercer county will receive bids at the office of J. L. Watson, Engr., 107 East State St., Trenton, until Sept. 11, for macadamizing three public roads.

TEXAS.—The commissioners of Travis county have appointed J. H. Washington and L. D. Gallaway, and Ed. Rogers and Alex. Rowe, members of committees to lay out certain new highways.

BRIDGES.

HOOSICK FALLS, N. Y.—The village trustees have voted in favor of issuing bonds for the proposed Church St. bridge: estmated cost, $19,500.

NEW YORK, N. Y.—Bids for constructing the new bridge over the Harlem River at Third Ave. were opened Aug. 29 from the following bidders: Michael S. Coleman, John J. Hopper, Rodgers & Farrell, Hart, Anderson & Barr, Andrew Onderdonk, Stewart & McDenmott, Clinton Stephens and Sooysmith & Co. There are 118 items in each bid, and several days will be required to tabulate the details; chief engineers' estimate, $1,125,000.

BALTIMORE, MD.—F. H. Smith, Consult. Engr., has prepared plans for a viaduct to avoid grade crossings on Eastern Ave.; length, 1,500 ft.; estimated cost, $45,000.

CLEVELAND, O.—Bids are asked until Sept. 20 for reconstructing the superstructure, masonry, foundations and approaches to the bridge over the Valley Ry. at South Water St. J. H. Farley, Dir. Pub. Wks.

VAN BUREN, MO.—The Van Buren Bridge Co. has been incorporated to build a bridge at this place; capital stock, $3,500.

WHARTON, TEX.—The county commissioners have voted to advertise for plans and specifications for a free bridge to be built over the Colorado River at this place, the cost not to exceed $23,000.

DENVER, COLO.—The board of public works is considering a petition for a viaduct over Fortieth St.; estimated cost, $20,000.

MONTREAL, QUE.—Press reports state that the Grand Trunk Ry. Co. will widen the Victoria bridge; also that a new bridge will be built across the St. Lawrence alongside the old one and on the old piers, which will be extended. It would be a double track open bridge, and the construction would be commenced at once.

WATER-WORKS.

AUBURN, ME.—The contract for laying 3,000 ft. 24-in. pipe from the city farm to the lake has been awarded to Bearce & Clifford, Lewiston, at $16,196.

ROCKLAND, ME.—The stockholders have authorized the Rockland Water Co. to purchase pipe and award contracts for the new works.

HAVERHILL, N. H.—It is reported that the Grafton county farm is to have a new supply.

HENNIKER, N. H.—F. E. Colby, C. B. Child and A. G. Preston have been appointed a committee to see what arrangements can be made with the Henniker Spring Water Co. for a supply for fire protection.

SUNCOOK, N. H.—A press report states that the works, formerly owned by S. S. Ordway, Woburn, Mass., have been taken under mortgage foreclosure by Frank Jones, Portsmouth, and that parties from Manchester and Concord are considering the purchase of them.

BURLINGTON, VT.—The plans for the extension of the intake into Lake Champlain have been completed and the work will soon be advertised, according to reports. About 2¼ miles of 24-in. cast iron pipe will be required, as stated in our issue of July 13.

CLINTON, MASS.—The commissioners are considering different plans for increasing the supply.

GREENFIELD, MASS.—The commissioners have purchased a 120,000-gallon pump of the Deane Steam Pump Co., Holyoke. A dam across Leyden brook is proposed at an estimated cost of $10,000.

COHOCTON, N. Y.—An election will be held Sept. 7 to vote on an issue of bonds for $22,500 for works.

DOLGEVILLE, N. Y.—Bids are asked until Sept. 16 for works, as stated in our advertising columns. The plans contemplate a dam and reservoir, laying 56,000 lin. ft. 12 to 4-in. cast iron pipe, 60 hydrants, etc. F. K. Baxter, Engr.

KINGSTON, N. Y.—An election has been called for Sept. 5 to vote upon the question of building new works.

LEROY, N. Y.—The trustees have voted to extend the mains 900 ft. and put in three additional hydrants.

McCONNELLSVILLE, N. Y.—T. Chrestian, Pres. McConnellsville Water Co., informs us that a gravity system is being put in for drinking purposes; population, 300.

MONTGOMERY, N. Y.—A meeting was held Aug. 29 to vote on the question of works; estimated cost, $10,000.

NEWBURG, N. Y.—Bonds for $40,000 have been voted.

OLEAN, N. Y.—J. E. & A. L. Case have contracted to secure a supply of 1,000,000 gallons per day from wells, which are now being drilled.

PINE HILL, N. Y.—The Pine Water Co. will award the contract for a gravity supply to R. W. Hill, the work to commence about Sept. 1; estimated cost, $15,000; population, 500.

SHERMAN, N. Y.—T. J. Newell, Vil. Clk., writes us that a private company of residents of the town will probably put in works next spring, the supply to be from springs; population, 950.

STAMFORD, N. Y.—The Stamford Water Co. is reported as planning to construct an additional reservoir 100 ft. higher than the present one.

WEST TROY, N. Y.—The village trustees have refused to renew the contract with the West Troy Water-Works Co. and a municipal plant is being discussed. The village has heretofore paid $10,000 a year for a supply, but both the quality and the quantity during the past year have caused much complaint, according to reports.

BAYONNE, N. J.—The city is considering plans for a new supply.

ORANGE, N. J.—The committee has proposed that a 1,500,000-gallon steam pump be placed at Campbell's Pond to secure an additional supply; estimated cost, $4,000.

ALTOONA, PA.—The Altoona "Tribune" states that the present supply is about 1,500,000 gallons while the consumption when water is plenty is 2,500,000 gallons per day, and that active measures are being considered for increasing the supply.

BELLWOOD, PA.—The Bellwood Water Co. has awarded the contract for pipelaying to A. H. Coon & Co., Tyrone.

CONEMAUGH, PA.—The Conemaugh & Franklin Water Co. wishes bids for hydrants, lead pipe, house connections, etc.; also for about 200 valves. F. D. Confer, Secy.

DALLAS, PA.—The Dallas Water Co. has been incorporated; capital stock, $10,000.

ETNA, PA.—The borough has voted to issue bonds for $85,000 to purchase the plant of the Etna Water-Works Co.

GREENFIELD, PA.—The town is reported as practically without water and much interested in the question of a supply.

MAHANOY CITY, PA.—The commissioners are advertising the sale of 4½% water bonds for works. R. T. Lewis, Comr.

MEYERSDALE, PA.—S. B. Philson, Secy. Sand Spring Water Co., writes us that the contract for works has been awarded to A. F. John, Meyersdale. The supply will be from a mountain stream and the works are estimated to cost about $25,000. Jas. H. Harlow & Co., Engrs., Pittsburg.

WYALUSING, PA.—A company is being organized to put in works. The reservoir will probably be about 2½ miles from the borough.

UPPER MARLBORO, MD.—The citizens are trying to secure an artesian supply.

WASHINGTON, D. C.—It is proposed to lay mains in unimproved streets so that the pavements will not have to be disturbed after the streets have been improved.

GRAFTON, W. VA.—The election Aug. 21 resulted 485 votes to 67 in favor of spending $50,000 for works. Alexander Potter, New York, has been engaged by the council to prepare the plans.

BELLAIRE, O.—The council has sold water-works bonds for $25,000.

CAMBRIDGE, O.—The council has contracted with John P. Martin, Xenia, for works, subject to a vote of the people. The ordinance provides for 12 or 13 miles of 14 to 4-in. mains, with 125 double-delivery fire hydrants, and a 20 × 120-ft. steel standpipe. The village is to pay $48 per year for each of the 125 fire hydrants and $40 per year for each additional one. The plant is to be completed within 18 months and within 60 days thereafter the village may buy it for $112,000, otherwise the contract is for 20 years.

CINCINNATI, O.—Bids were opened Aug. 26 for four steel tanks for Price Hill, each to be 30 × 30 or 30 × 50 ft. and supported by an iron trestle or masonry foundation. The bids, according to the "Commercial Gazette," were as follows:

	30×30.	30×50.	Iron work.
Cincinnati Architectural Iron Works	$24,861	$29,233	....
Toppet & Wood, New Jersey	31,815	38,973	.....
Stacey Manufacturing Co.	28,357	41,246	.....
L. Schrieber & Sons	31,746	51,594	$1,440
L. Schreiber & Sons (if holes are punched)	29,131	45,987	.....
Riter & Conley, Pittsburg	21,763	27,436	.....
Columbus Bridge Co. (punched)	21,527	28,327	.....
M. Clemens Iron Co.	27,457	41,950	.....

——The citizens of Clifton Heights have petitioned the board of administration for a better supply.

LOCKLAND, O.—The council has accepted a proposition of the Reading water-works trustees for a supply, at prices ranging from 6½ cts. per 1,000 gallons for 25,000 gallons to 4 cts. if 150,000 gallons are used.

MADISONVILLE, O.—The citizens have voted to issue bonds for $5,000 for improving the system.

MANSFIELD, O.—There is talk of constructing a reservoir at an estimated cost of $25,000. Other plans are also being considered to secure an increased supply.

ORRVILLE, O.—The opening of bids for works has been postponed 10 days from Aug. 22, pending the sale of bonds now being negotiated. Alexander Potter, Consult. Engr., New York.

PLAIN CITY, O.—Bonds for $30,000 for works and electric lights are being advertised.

GRAND RAPIDS, MICH.—Mayor Stuart is urging the council to secure a better supply at once.

HOUGHTON, MICH.—An election will be held Sept. 11 to vote on an issue of bonds for $10,000 for a new reservoir and to extend the mains to East and West Houghton.

HOWELL, MICH.—The citizens have voted, 474 to 54, in favor of bonds for $39,000 for works.

MARCELLUS, MICH.—It is reported that works will be constructed.

HIGHLAND PARK, ILL.—Joseph G. Falcon, Evanston, has been awarded the contract for laying an intake pipe 2,000 ft. into Lake Michigan for the new supply. About 40 16-in. Falcon flexible joints will be used. The Addystone Pipe & Steel Co., Cincinnati, O., will furnish the pipe. A settling well and pump-house are to be built. W. S. Shields, Engr., Chicago.

LATHAM, ILL.—Plans for works have been prepared, according to reports, including a standpipe 50 ft. high. The question has not yet been voted upon by the people.

STANFORD, ILL.—There is talk of a special election to vote on the question.

VIRDEN, ILL.—It is reported that works will be put in.

CENTRALIA, WIS.—A proposition for works has been made to the council, which it is reported will probably be accepted.

HILLSBORO, WIS.—The citizens have voted in favor of works by a majority of 14 votes.

SOUTH MILWAUKEE, WIS.—It is stated that unless C. E. Gray & Co., to whom a franchise was recently awarded, commence work on a system before Oct 15 the village board will arrange for municipal works. An election is proposed to vote bonds for this purpose: estimated cost, $15,000 for a supply from springs or $50,000 for a supply from Lake Michigan.

ATCHISON, KAN.—The Atchison St. Ry. & Electric Light Co. has been granted a franchise for works.

LAWRENCE, KAN.—The Kansas Water & Light Co. closed its plant Aug. 25, owing to a disagreement with the city, and the city is reported as wholly without a supply.

NORFOLK, NEB.—An election will be held Sept. 23 to vote on an issue of $40,000 of 20-year 6% bonds for purchasing the works of the Norfolk Water-Works Co. The city pays the company $4,620 per year hydrant rental, with $60 per year for each additional hydrant.

SYRACUSE, NEB.—A committee has been appointed to investigate the question of works.

DELL RAPIDS, S. DAK.—The city authorities are reported as prospecting for a supply, for which bonds have been voted.

SPEARFISH, S. DAK.—The question of meters and of a reservoir are being considered.

ANDERSON, MO.—The contract for works has been awarded to Jno. Gabriel, Carthage.

LEBANON, MO.—J. A. Smith, St. Louis, is preparing plans for works for the Lebanon "Journal."

EL PASO, TEX.—An election will be held Sept. 12 to vote on an issue of water bonds for $175,000.

FORT WORTH, TEX.—The council has voted to construct a dam across the Clear Fork: estimated cost, $2,500; capacity of reservoir, 21,000,000 gallons.

ASPEN, COLO.—It is reported that the money for the proposed works is about secured and that construction will soon be commenced.

COLORADO SPRINGS, COLO.—The council has voted to issue $15,000 of 8% bonds to run one year for the work noted in our issue of Aug. 17.

EDDY, N. MEX.—The City Water-Works Co. has been incorporated by W. A. Hawkins, Frederick Dominice, J. A. Eddy and others; capital stock, $100,000.

BALLARD, WASH.—Stewart K. Smith, Cy. Engr., writes us that an election will be held Sept. 13 to vote on an issue of bonds, of which $60,000 would be for works, but that no definite plans have yet been made.

COLVILLE, WASH.—R. B. Thomas, Cy. Engr., is preparing plans for works estimated to cost about $20,000. It has not yet been decided whether the city will construct the works or grant a franchise.

SPOKANE, WASH.—The council has engaged Riblet & Huber, Spokane, to prepare plans for the new works. The plans are expected to be ready in September and are to be approved by an engineer of national reputation, selected by Riblet & Huber. The council has not yet decided whether the work will be done by contract or day labor.

NEWBERG, ORE.—The question is being discussed.

OAKLAND, ORE.—An election has been held to vote on the question of works.

PORTLAND, ORE.—It is reported that the contracts for the three reservoirs have been awarded to the lowest bidders, the construction to be commenced at soon as possible. The bids received for the reservoirs and also for laying the submerged pipe were published in our issue of last week.

SANTA ROSA, CAL.—Plans have been prepared for a supply from wells, and bonds for $165,000 have been voted. The city had a population of 5,216 in 1890, and has no other indebtedness. The construction of the proposed works depends upon the sale of the bonds. Newton V. V. Smyth, Cy. Engr.

DE SMET, IDAHO.—It is reported that works will be constructed.

BEAUFORT, QUE.—The Beaufort Asylum has been granted authority to secure a supply.——The council of Limoitou (St. Roch, North) has decided to acquire a spring some miles beyond the asylum at this place and build works; estimated cost, $48,740.

HULL, QUE.—An election will be held in September to vote on an issue of bonds for $40,000, for extensions and street improvements.

SPRINGBANK, ONT.—The works are being examined with a view to increasing the supply and improving the pumping capacity.

PORTAGE LA PRAIRIE, MAN.—The Portage la Prairie Land & Power Co. is being organized by Geo. H. Webster, Engr., and others to develop water power privileges and to construct and operate water-works in this place; capital stock, $100,000.

SEWERS.

LACONIA, N. H.—Bids are asked until Sept. 11 for 7,845 lin. ft. 15-in., 1,805 lin. ft. 10-in., 8,815 lin. ft. 8-in., and 20,335 lin. ft. 6-in. vitrified pipe sewer, as stated in our advertising columns. Wm. Nelson, Supt.

BEVERLY, MASS.—The town has voted to issue bonds for $100,000 for a system.

SHELBURNE FALLS, MASS.—E. E. Davis, Northampton, is preparing plans.

WALLINGFORD, CONN.—Fraray Hale, Clk., informs us that the borough will buy about 5,000 lin. ft. 24 to 12-in. tile and employ men out of work to construct the sewers.

JOHNSTOWN, N. Y.—It is probable that plans will soon be prepared for a system.

NEWBURG, N. Y.—The city clerk has been directed to advertise for bids until Oct. 3 for the proposed trunk sewer in West Newburg.

NIAGARA FALLS, N. Y.—The Cataract Construction Co. has obtained permission to construct a system of sewers on its property near the new station of Echola.

NORTH TONAWANDA, N. Y.—T. W. Barrally, Cy. Engr., has prepared plans for important extensions, some of the work probably to be done next year. The work includes a combined system for the new districts as well as a scheme for improving the portion of the system constructed some years ago but which is now proving inadequate. Chas. C. Brown, Schenectady, is Consulting Engineer of the work.

ROCHESTER, N. Y.—The contract for the West Side sewer has been awarded to Lee & Minahan, Paterson, N. J., at about $325,000. The only other bid was that of E. J. Rosenfield, Des Moines, Ia., and J. E. Shields, Rochester, at $869 above the successful bid, accepting the estimated quantities as correct. The commission's estimate of the cost of the sewer was $386,000.

MILLVILLE, N. J.—Plans for a system have been prepared by Wise & Watson, Passaic. The total length is about 30 miles, and estimated cost $137,000, of which only about half would be necessary to be constructed at present.

WILLIAMSPORT, PA.—Townsend & Co. have been awarded contracts at $1,357 and $10,778. D. L. Miller, Lock Haven, bid $1,468 and $10,835, respectively, for the work.

WASHINGTON, D. C.—The district commissioners will receive bids until Sept. 2 for sewer brick and cement.

ALLIANCE, O.—Bids will be received by the City Clerk until Sept. 7 for 2,870 lin. ft. 18-in., 3,018 lin. ft. 15-in., and 2,026 lin. ft. 12-in. pipe sewer; two contracts. L. E. Chapin, Consulting Engineer, Canton.

CLEVELAND, O.—It is reported that work will soon be commenced on the Walworth run sewer, about two miles in length.

COLUMBUS, O.—Bids are asked until Sept. 6 for three pipe sewers. F. M. Senter, Clk. Bd. Pub. Wks.

NORWOOD, ILL.—The lowest bid for the first section of the system was that of B. D. Barton, Cincinnati, at about $14,000.

FRANKFORT, IND.—Charles C. Brown, Schenectady, N. Y., has prepared plans for a system of about 22 miles for sewage only with separate storm water sewers for two or three small districts and one large one. A small stream runs through the city which can readily be fitted to take the storm water, but is neither large enough nor at low enough level to take the sewage. An outlet line of more than two miles length beyond the city limits is necessary to give a good and sufficient method of discharge. It is probable that within a few years a plant for treating the sewage before discharge will be necessary. The outlet line is 24-in. pipe, and the rest of the system is 6 to 12-in., the greater part being 8-in. Unless the financial outlook brightens no part of the system will be constructed at present. A. J. Hammond, Cy. Engr.

BELLEVILLE, ILL.—Edward Fladd, St. Louis, has prepared plans for a system; total length, 37 miles; estimated cost, $188,604.

HINSDALE, ILL.—Bids are asked until Sept. 4 for five brick and pipe sewers. E. P. Hinds, Vil. Pres. C. McLennan, Engr., 100 Washington St., Chicago.

LINCOLN, ILL.—Bids are asked until Sept. 7 for the reconstruction of the Rubicon sewer near the mouth of the sewer. Frank Bollin, Cy. Clk.

PEORIA, ILL.—Bids are asked until Sept. 8 for 3,633 lin. ft. 36 and 30-in. brick sewer, and 6,799 lin. ft. 20 to 12-in. pipe sewer, as stated in our advertising columns. Jacob A. Harman, Cy. Engr.

BALLARD, WASH.—An election will be held Sept. 13 to vote on an issue of bonds, of which $40,000 are proposed for sewers. Stewart K. Smith, Cy. Engr.

HAYWARDS, CAL.—The citizens have voted 248 to 58, in favor of issuing bonds for $33,000 for a system. The main sewer will be five miles long, the disposal being into the bay at low tidewater.

WALKERTON, ONT.—The provincial board of health has approved plans for a system reported to be similar to that at the Agricultural College, Guelph, or at Lawrence, Mass.

STREETS.

SALEM, MASS.—The city has been directed by the county commissioners to advertise for bids until Sept. 11 for a part of the proposed street over the Harmony Grove flats between this city and Peabody.

BUFFALO, N. Y.—For paving Moselle St., Bird Ave. and Chandler St. the German Rock Asphalt Paving Co. bid $18,799, $14,449 and $24,987, respectively, and the Barber Asphalt Paving Co., $19,017, $14,185 and $24,528.

NEW YORK, N. Y.—The commissioner of public works will receive bids until Sept. 11 for 17 contracts for paving with granite blocks, flagging, etc.

YONKERS, N. Y.—The commissioner of public works will receive bids until Sept. 11 for macadamizing Yonkers Ave.

CAMDEN, N. J.—The Granite Block Co. has been organized to make Belgian and rubble blocks; Pres., H. D. Fling, Philadelphia; Secy., G. W. Jessup; Treas., W. F. Rose.

JERSEY CITY, N. J.—Bids are asked until Sept. 11 for improving several streets by grading, paving, etc. Geo. T. Bouton, Clk. St. Comrs.

GREENSBURG, PA.—It has been decided to pave portions of Main and Best Sts. and Maple Ave.

HENDERSON, KY.—Bids are asked until Sept. 4 for paving with brick. Jno. C. Atkinson, Mayor.

CLEVELAND, O.—Bids are asked until Sept. 23 for paving Genesee St., between Hough and Wade Park Aves., with brick. John H. Farley, Dir. Pub. Wks.

COLUMBUS, O.—Bids are asked until Sept. 6 for paving. F. M. Senter, Clk. Bd. Pub. Wks.

INDIANAPOLIS, IND.—The board of public works will receive bids until Sept. 6 for paving with cobble stones and brick.——Resolutions have been passed for improving 15 alleys and streets, including 1,820 lin. ft. brick paving.

TERRE HAUTE, IND.—Bids are asked until Sept. 19 for street and sidewalk improvements. Chas. H. Goodwin, Cy. Clk.

KEOKUK, IA.—Bids are asked until Sept. 4 for grading, curbing and macadamizing 12th St., from Seymour St. to Grand Ave. W. H. Jones, Cy. Engr.

TACOMA, WASH.—The contract for paving Pacific Ave., from 17th to 25th St., has been awarded to the Tacoma Bituminous Paving Co., at $69,950.

ELECTRIC LIGHT AND POWER.

BOSTON, MASS.—Bids are asked until Sept. 5 for wiring the buildings for contagious diseases at city hospital for electric lighting. Edmund M. Wheelwright, City Architect.

WINTHROP, MASS.—The selectmen have been instructed to make a five-year contract with the North Shore Electric Light Co., at $72 per year for arc lights and $15.50 for incandescent lights, the lights to burn until 1:30 a. m.

WESTERLY, R. I.—The Westerly Gas & Electric Light Co. has been awarded a contract for 60 incandescent lights of 25 c. p., at $15 per light per year.

ETNA, PA.—The citizens have voted to issue bonds for $15,000 for an electric light plant.

FOREST CITY, PA.—The borough has granted an exclusive franchise for five years, and contracted for lights at $75 each per year if used all night, or $60 if burned until one o'clock.

MUNCY, PA.—The council has granted a franchise to the Muncy Electric Light Co. Henry Lenhart, Philadelphia, is organizing the company, which will be composed mostly of local parties.

MADISONVILLE, O.—At a special election Aug. 26, the citizens voted to issue bonds for $15,000 for an electric light plant.

WASHINGTON C. H., O.—The Washington Electric Light, Heat & Power Co. has increased its capital stock from $10,000 to $30,000.

WESTWOOD, O.—Bonds for $25,000 for an electric light plant were voted some time ago, and it is thought that the council will take some action on the matter at the next meeting, Sept. 4.

RICHMOND, IND.—A franchise has been granted to the O. C. Irwin & Co. The question has been under discussion several months.

DETROIT, MICH.—The contract for conduits for the municipal electric light plant has been awarded to Liphardt & Winterhalter, Detroit. The itemized bids were published last week.

WAUWATOSA, WIS.—Bids are asked by the Village Clerk until Sept. 4 for eight 2,000-c. p. arc lights and 60 20-c. p. incandescent lights for five years.

BOONE, IA.—The Boone Electric St. Ry. & Light Co. is putting in a plant for both lighting and power purposes. The completed plant is estimated to cost about $125,000. The work is being done by Westinghouse, Church, Kerr & Co.

CLEBURNE, TEX.—The Cleburne Water, Ice & Lighting Co. has been awarded a contract for seven 1,600-c. p. arc lights and 80 32-c. p. incandescent lights, at $1,800 per year.

BALLARD, WASH.—An election will be held Sept. 13 to vote on an issue of bonds, of which $11,000 are proposed for electric lights. Stewart K. Smith, Cy. Engr.

PORTAGE LA PRAIRIE, MAN.—The Portage la Prairie Land & Power Co. is being organized to develop the water power privileges on the Assinaboine River or other streams. Dams and power houses are proposed, and electricity would be generated for lighting, heating and power purposes. George H. Webster, Engr., is interested; capital stock, $100,000.

SANTIAGO, CHILE.—Bids are asked until Dec. 30 for lighting the streets and public squares of the city by electricity. Information can be obtained of the Consul-General in New York, or of the consular offices of Chile in either Philadelphia, Boston or Chicago.

NEW COMPANIES.—Midwood Electric Light, Heat & Power Co., Flatbush, N. Y.; $50,000; William Matthews, A. I. Ditmas, J. Z. Lott, S. L. Vanderveer.

CONTRACT PRICES.

PIPE.—Evansville, Ind.—A contract for 100 tons 6-in. pipe has been awarded by the water-works trustees to Dennis Long & Co., Louisville, Ky., at $20.39 per ton.

Auburn, Me.—The contract for 3,000 ft., about 300 tons, 24-in. cast iron pipe has been awarded to R. D. Wood & Co., Philadelphia, at $28.60 per gross ton delivered in this city.

Conemaugh, Pa.—The Conemaugh & Franklin Water Co. has awarded the contract for all pipe to the National Foundry & Pipe Works, Scottdale, at $22.80 per ton. F. D. Confer, Secy.

SEWER BRICK.—Portland, Me.—A contract for 250,000 brick for sewer construction has been awarded to Melvin Hamblet, Deering, at $8 per M. Geo. N. Fernald, Cy. Engr.

CEMENT.—Portland, Me.—Carleton Bros. & Co., Portland, have been awarded a contract for 1,000 bbls. American cement, Hoffman brand, at $1.18, and 100 bbls. Portland cement, Booth brand, at $2.40.

PAVING BRICK.—Quincy, Ill.—A contract for 1,000,000 paving brick has been awarded to the St. Louis Paving Brick Co., Galesburg, at $10.25 per M. f. o. b. in this city. The Galesburg Brick & Terra Cotta Co. bid $10.75.

WATER-WORKS.—Piedmont, W. Va.—The contract for the construction of water-works was awarded to L. G. Hallock, Wheeling, at $36,100, as stated in our issue of last week. Separate bids on material were received from 16 firms, the prices ranging as follows: For two duplex pumping engines, 750,000 gallons capacity each, and two horizontal tubular boilers, 70 HP., $2,950 to $5,600; brick pumping station with suction well and intake dam, $3,072 and $4,600; 4, 6 and 10-in. cast iron pipe, $23.40 and $24 per ton; special castings, $2.50 and $2.64 per cwt.; constructing masonry reservoir, 200 × 70 ft. and 10 ft. deep, walls of broken range rubble in cement; $9,000 to $13,500; rock excavation, $3 to $3.60 per cu. yd. (one bid at $1); double nozzle hydrants, $22 to $25.50 each; gate valves, 4-in., $6 to $8; 6-in. $9 to $12.90 10-in., $19.50 to $26.50; street valve boxes, 4-in., $2.50 to $4; 6-in., $2.50 to $4.25; 10-in., $2.50 to $4.75; trenching and pipe laying, mains 4 ft. deep, 4-in. pipe, 16 to 30 cts. per lin. ft.; 6-in., 22 to 35 cts.; 10-in., 30 to 65 cts.; 10-in. check valves, $25 to $38. Alexander Potter, Designing Engr., New York.

SEWERS.—Boston, Mass.—The following bids were received for section 44½ of the main sewer, in Winchester: 1, Jones & Meehan, Jamaica Plain. $44,900; 2, T. F. Crimmings and D. C. Collins, Somerville, $39,922; 3, Everson & Liddle, Providence, $39,871; 4, John Sheehan, Lynn, $37,155; 5, Chris. McBride, Brighton, $35,320; 6, Thos. J. Young & Co., Boston, $35,098; 7, National Con. Co., Boston, $33,005; 8, Chas. Linehan, Cambridge, $32,485; 9, Weaving, Booth & Co., Dorchester, $31,047.

The work is given in this order: A, Earth excavation and refill, 35 × 39 and 33 × 37 ins., 5,700 lin. ft.; B, brick masonry, American cement, 970 cu. yds.; C, Portland cement, 370 cu. yds.; D, concrete masonry, American, 350 cu. yds.; E, Portland, 130 cu. yds.; F, spruce lumber in place, 15 M. ft. B. M.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
A ...	$3.80	$3.15	$3.00	$3.00	$2.60	$2.65	$2.40	$2.00	$2.20
B ...	14.00	13.50	13.50	12.40	12.50	12.15	11.90	13.00	11.75
C	16.00	14.75	15.50	14.00	14.00	13.75	13.25	16.00	13.20
D	6.00	5.75	6.50	4.50	5.00	5.00	4.50	4.00	3.40
E	8.00	6.75	8.20	5.75	6.50	6.50	6.00	6.00	4.85
F ...	40.00	35.00	40.00	35.00	40.00	35.00	35.00	25.00	27.00

Portland, Me.—A contract for 1,015 lin. ft. of 60 × 75-in. masonry sewer has been awarded to Thos. Shanahan, Portland, at $4,677, as noted last week. Geo. N. Fernald, Cy. Engr., informs us that the city will furnish all masonry except stone for rubble masonry, and that all material will be delivered near the line of work by the city, except broken stone for concrete and sand, which the contractor will haul about 500 ft. The prices were as follows: Earth excavation, 2,400 cu. yds., at 50 cts.; rock excavation, $3.50; concrete masonry, 500 cu. yds., $2; brick masonry, 340 cu. yds., $4.50; rubble masonry, 86 cu. yds., $4; pipe laying, 120 lin. ft., 3 cts.; spruce or hemlock, 8 M. ft. B. M., $15; earth filling, 1,200 cu. yds., 40 cts.; sheeting left in place, $10.

MACADAMIZING.—Elizabeth, N. J.—Louis Quien, Co. Engr., opened bids Aug. 22 for the following work: Newark Ave., 1, excavation, 2,000 cu. yds.: 2, filling, 1,000 cu. yds.; 3, telford macadamizing, 9,200 sq. yds.; Springfield Ave., 1, excavation, 7,800 cu. yds.; 2, telford macadamizing, 14.660 sq. yds.; Morris Ave., 1, excavation, 13,500 cu. yds.; 2, macadamizing, 5,910 sq. yds.; 3, telford macadamizing, 6,700 sq. yds.; Edgar road, 1, excavation, 8.200 cu. yds.; 2, telford macadamizing, 18,930 sq. yds. The bids are given in this order: A, Hillpot & Ayres; B, Brendlinger & Nearing; C, Wright & Linsley; D, Wm. Chamberlain; E, T. McManus; F, H. Lighthike; G, James Carroll; H, P. Faughner; I, C. W. Smith; J, J. F. Shanley.

	Newark Ave.			Springfield Ave.		Morris Ave.			Edgar Road.	
	1.	2.	3.	1.	2.	1.	2.	3.	1.	2.
	Cts.	Cts.	$	Cts.	$	Cts.	$	$	Cts.	$
A....	29	35	1.22	29	0.92	32	0.72	0.96	29	1.05
B....	..	..	....	25	1.09	30	0.84	1.09	..	....
C	..	..	....	30	1.23	30	0.90	1.39	..	....
D	..	..	....	29	0.89⅞	..	....	....	35	0.93
E....	..	..	....	48	1.75	52	1.30	1.85	..	....
F	..	..	....	25	1.20	40	1.15	1.40	..	....
G....	25	28	1.05	28	1.02	32	0.74	1.13	28	1.15
H	15	22	0.95	..	....	..	....	....	..	....
I.....	38	25	1.07	..	....	..		....	25	1.17
J ...	15	33	0.99	..	....	..	....	....	23	0.98

MISCELLANEOUS.

NATURAL GAS PLANT.—Logansport, Ind.—About $128,000 is reported as already subscribed toward a new natural gas plant.

WHARF WORK.—Ottawa, Ont.—Bids are asked until Sept. 29 for the construction of a wharf at Grand Etang, Inverness Co., N. S. E. F. E. Roy, Secy. Dept. Pub. Wks.

CISTERN, BOILER, ETC.—Columbia, Tenn.—Bids will be received at the Columbia Arsenal until Sept. 22 for constructing a 120,000-gallon cistern; also for furnishing and setting in place a boiler, iron tank, steam pump, etc. Capt. John E. Greer, U. S. A.

COURT HOUSE.—Fort Worth, Tex.—The contract for the Tarrant county court house, recently noted in these columns, has been awarded to the Probst Construction Co., Chicago, at $408,000 for granite, the stone to be dressed in this city and the building completed in 18 months. There were 13 bids received.

BUILDINGS.—Harrisburg, Pa.—Bids are asked until Sept. 25 for a center or administration building for the Pennsylvania State Lunatic Hospital. Addison Hutton, Architect, 400 Chestnut St., Philadelphia.

Urbana, Ill.—Bids are asked until Sept. 11 for the construction of an engineering building for the University of Illinois. W. L. Pittsbury, Secy.

FIRE ENGINE.—Cincinnati, O.—Bids are asked until Sept. 4 for a crane-neck, double-pump steam fire engine, with patent equalizing platform springs and forced circulating coil boiler constructed of the best quality of homogeneous steel of sufficient strength to bear twice the pressure ever required for fire service, to be surmounted with brass dome, and delivered in this city for trial and acceptance within 30 days from date of award of contract. Thos. Brown, Secy. Bd.

INDUSTRIAL NOTES.

LOCOMOTIVES.—H. K. Porter & Co., Pittsburg, Pa., are about to ship 2 double-ender engines and 2 small street motors, standard gage, to a tramway in Buenos Ayres, South America; also a small 30-in. gage engine to Santo Domingo.

The Raub Locomotive Works have signed a contract to locate their works in the south part of Elwood, Ind., according to a press report.

CARS.—The Ryan-McDonald Mfg. Co., Baltimore, Md., is working on a government contract for double dump steel cars for transporting concrete, sand and stone. It has a contract also with the Standard Oil Co. for six steel tanks to be erected in different states in the South.

The Michigan-Peninsular Car Co., Detroit, Mich., has shut down for a period of three months.

BRICK PLANTS.—Thomas Carlin's Sons, Allegheny, Pa., are about starting a new red brick plant for the Builders' Supply Co. The large plant of the J. M. Rumbaugh Brick Co., which was built by them, contains some of their largest and heaviest grinding machinery for making red brick from shale rock, and it is claimed that they turn out the finest brick in the Pittsburg market. The capacity is about 60,000 per day.

ARCHITECTURAL PHOTOGRAPHS.—Chas. Stadler, Civil Engineer, and Henry E. Torgersen, Architect, have formed a partnership with the firm name of Stadler & Torgersen, to make a specialty of taking engineering and architectural photographs in Chicago, or any other part of the country where the work is of sufficient magnitude to justify their submitting propositions. They are also introducing a new process for photographing drawings, etc., which gives black lines on a white ground instead of chocolate colored lines on a tinted ground, as in the ordinary photograph. Offices, 1,641 Unity Building, Chicago, Ill.

THE LITOFUGE BOILER COMPOUND is being extensively used in the boilers of street railway power stations. In San Francisco, for example, the San Mateo power station, the Sutter St. line, and the Ferries & Cliff House Ry. are using it, and praise it heartily for its value in removing scale. On the other side of the continent the Lime Rock R. R. Co., of Rockland, Me., have used it in locomotive boilers for two years, and state that they consider it invaluable.

THE ANDERSON & BARR CLAY CO. has been organized by Messrs. John F. Anderson and C. C. Barr, the well known contractors, and a large plant, for the manufacture of vitrified paving brick and pressed building brick, has been erected at Streator, Ill. The clay is dug from the bank by a steam shovel, is ground, mixed and molded by machinery of the latest pattern and is burned in a continuous kiln. The total capacity of the complete plant is expected to reach an output of 48,000,000 bricks per annum.

THE DODGE MANUFACTURING CO., Mishawaka, Ind., has issued a neat souvenir pamphlet describing the company's extensive exhibits at the Columbian Exposition, and giving a brief account of the marvelous growth of the company's business, which has developed from a little wooden two-story 20 × 40 ft. shop in 1878 to a plant covering 60 acres at present, with a total floor area in factories and warehouses of 16 acres. Some interesting features of modern power transmitting machinery are described, and the book is finely illustrated.

NEW COMPANIES.—The Bucyrus Steam Shovel & Dredge Co., South Milwaukee, Wis.; $150,000; John M. Millman, A. W. Robinson, W. B. Crittenden.—Indiana Gas Generating Machine Co., Chicago, Ill.; $125,000; John A. Enos, G. G. Beresford, J. P. W. Brown.

Proposals for Excavating.

SANITARY DISTRICT OF CHICAGO.
—TO CONTRACTORS.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago and indorsed

"Proposal for Excavating a Portion of the Main Drainage Channel" will be received by the Clerk of the said Sanitary District at Room H, Rialto Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 4th day of October, 1893, and will be publicly opened by the said Board of Trustees at the regular meeting held that day or at a special meeting called for that purpose.

The work for which the said tenders are invited is the excavation of that portion of the main drainage channel for the said Sanitary District, between Willow Springs and Joliet, Ill., known as contract sections two (2), three (3) and four (4), and consists in all of about 1,484,800 cubic yards of rock, of about 2,179,500 cubic yards of earth, the building of about 76,466 cubic yards of dry rubble walls.

Each of said sections will be treated as a separate contract in canvassing the proposals and making awards. As all awards will be made by individual sections, each bidder must make prices for each section separate and distinct from every other.

Each proposal must be accompanied by a certified check or cash to an amount equal to $3,000, multiplied by the number of sections bid upon.

All certified checks must be drawn on some responsible bank doing business in the city of Chicago, and be made payable to the order of the Clerk of the Sanitary District of Chicago. Said amount of $3,000 for each section will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed, the return of said check or cash being conditioned upon any bidder to whom an award of any portion of said work may be made appearing within ten days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for the section or sections of said work so awarded, and giving a bond satisfactory to said Board of Trustees for the fulfillment of the same in the amount of $100,000 for each section of work awarded him.

All proposals must be made upon blank forms furnished by the Sanitary District and must give the price for each separate item of work.

The bids will be compared on the basis of the engineer's approximate estimate of quantities, which will be furnished with copies of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work, and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may be seen at the office of the Chief Engineer, Rialto Building, Chicago, Ill.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.
Attest: THOMAS F. JUDGE, Clerk.
Chicago, Ill., Aug. 5, 1893. 32-8t